No. 1924 Vol. XLVIII NOVEMBER 8th, 1945

FLIGHT

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FLIGHT
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FIRST AERONAUTICAL WEEKLY IN THE WORLD : FOUNDED 1909

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The Outlook

More Delays

MORE disquieting even than the plan for nationalising our commercial aviation announced by Lord Winster on November 1st is the long delay which the plan will inevitably impose before this country can make any sort of start. The legislation that will be needed will take a long time, and meanwhile our competitors, notably the United States, will have an opportunity to get firmly established, an opportunity which they are not in the least likely to overlook.

Nationalisation might be the ultimate goal, but to introduce it at a time when literally every moment counts if we are not to be left irrevocably behind in the race for world markets is nothing short of a national calamity. The curse of British commercial aviation has always been that it has been the plaything of politicians who, when they have troubled to think about it at all, have generally thought along the wrong lines and drawn erroneous conclusions from false premises. If only it could have been left to the technicians and practical operators without undue interference from bureaucracy, we should not be in the lamentable position in which we find ourselves to-day.

Lord Winster argued that air transport is a young industry and that a youthful approach to it is necessary. "Childish" would more appropriately describe the approach which the Government has made. Anything more impractical and time-wasting than the three Government-owned monopoly corporations which it is proposed to establish is difficult to imagine. The "youthful approach" advocated by Lord Winster is to draw "vigorously and with imagination on ideas and experience so as to ensure the fullest and most rapid development. Only so shall we arrive at an established corpus of factual and proved knowledge in regard to operating." We are not at all certain what that means, or if it means anything. Whose ideas? Whose experience? Apparently B.O.A.C. is to run everything until such time as the other two corporations can be established and the position of B.O.A.C. itself brought into line. The Minister proposes to have consultations with surface transport interests, but in view of the fact that he has excluded them from participating in air transport they can hardly be expected to be enthusiastic about divulging their plans and experiences. So the ideas and experience will have to come mostly from B.O.A.C.

The Wolf and the Lamb

AS for discussing with surface transport interests "how far co-operation is possible, and how the mutual interests of transport by land, sea and air can best be served within the framework of the Government's policy," obviously the answer is "not very far" unless and until the Government nationalises railways and shipping and decides who is to carry which and in what. Present operators are not in any case to receive anything for goodwill, but only "fair payment for physical assets." In the main that will mean that present operators may get a fair price for worn-out and obsolete flying equipment but nothing for their other assets, many of which will be far more valuable. And independent operators are clearly warned by Lord Winster that they are free to carry on during the interim period, but that they can expect nothing for doing so.

The Minister of Civil Aviation concluded with an argument which was quite unworthy of him. Of the history of the Mercantile Marine he said that services had been built up amid a scramble for profits which inflicted inhuman misery and cruelty upon fine seamen who had

been treated like beasts, and that the young pilots who flew our civil aircraft, and who were engaged in developing our civil aviation, should feel that they were engaged in service to the community and the community alone. It seems to us that if the Mercantile Marine had depended for its growth upon boards of civil servants, such as it is now proposed to set up for the air transport corporations, the crews might or might not have had a happier time of it, but we should certainly not have established the lead which we did establish.

The Two Freedoms

WITH the spectre of nationalised monopoly hovering over us we must be grateful for small mercies. Lord Winster did announce two "freedoms," the only two towards which we may look. Charter flying will be undertaken by the Government-owned corporations, but they will not have a monopoly of this, and private interests may, if they so wish, engage in this kind of enterprise. One assumes that to mean that a small struggling firm with three or four aircraft may compete against what will virtually be State-subsidised operating companies.

The second freedom promised is that of private flying, on which there will be no restriction "aside from safety regulations." That sounds very well, and it is good news to learn that the Minister of Civil Aviation has consulted his "noble friend the Secretary of State for Air" and is able to announce, "with his concurrence, that he will remove the ban on private flying with effect from January 1st, 1946." That is certainly something to be thankful for. But, apart from several other considerations, there is the little matter of petrol. One cannot imagine the Government allowing flying clubs and private owners to obtain petrol which is denied motorists, so here is a fruitful source of delay unless the Government proposes to abolish petrol rationing on January 1st.

Thus, at the moment, it would appear that gliding is likely to be the only form of club and private flying in which it will be possible to indulge early next year.

Waiting for Weather

AS the weeks slip by one realises more and more how unfortunate it was that there was disclosure of the plans for beating the world's speed record. Had the secret been kept, as it was intended it should be, the public, and, indeed, the world, would have been thrilled by the announcement of the feat. As it is, there has been so much talk about the attempt and so apparently little of achievement that the general public has lost interest.

The man in the street, while ready to be impressed by a really noteworthy feat, cannot be expected to understand the difficulties in spite of the explanations, some good, some not so good, given in the Press and on the radio. He could not appreciate that a day when there are no "bumps" in the air is essential, or that visibility of at least five miles is necessary if the pilots are to have a chance of getting the best out of their machines without running undue risks. Even with the weather in their favour they have enough to contend with. Although the cockpit of a jet-driven aircraft is of simple layout and with few "gadgets" compared with ordinary aircraft, at speeds around 600 m.p.h. and flying at some 200ft. or less, the pilot has little time, if any, in which to glance at his instruments, and so the conditions "outside" must be such that he can guide his machine with accuracy without having to change focus and direction of view during the run over the measured course. "Bumps" are not merely extremely unpleasant at these speeds; they may throw the aircraft into a downward-sloping flight path which would land the aircraft in the water in a matter of a second or two. But the public cannot know these things, and it will now be less impressed than would have been the case if nothing had been said before the event.

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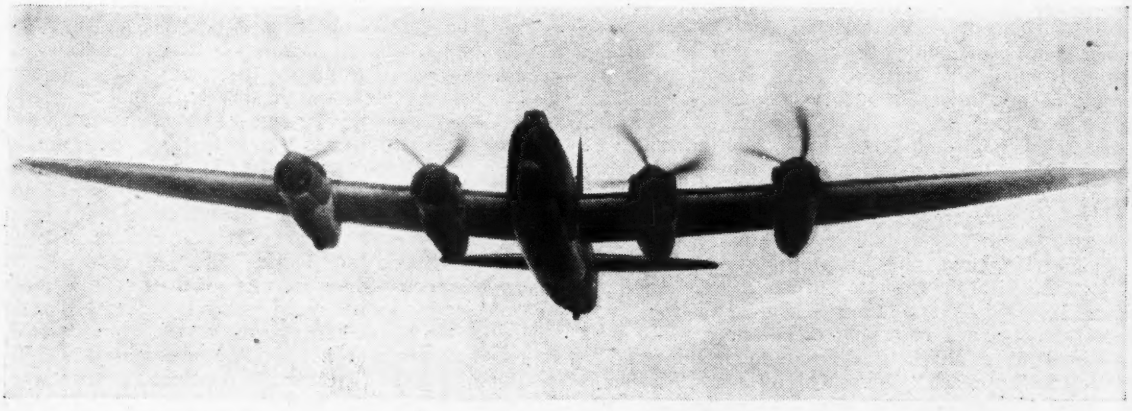


WELLINGTON'S BIG BROTHER : With its four undercarriage legs retracted into the engine nacelles, the Vickers-Armstrongs Windsor Mk. I bomber presents a very clean appearance from the head-on aspect. The engines are Rolls-Royce Merlins of the 85 series and they drive four-bladed Rotol airscrews.

Firefly IV

Latest Version of Famous Fleet Fighter : Leading Edge Radiators, Clipped Wings and Different Tankage

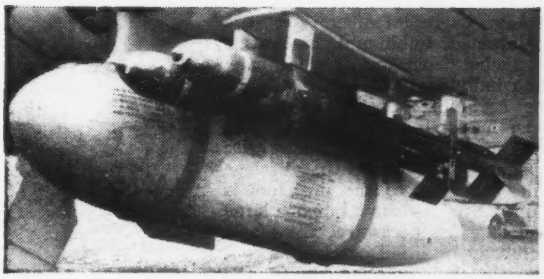
An already good fleet fighter further improved : the Firefly in its Mk. IV form.

THE Fairey Firefly has already been described both in general terms (*Flight*, December 7th, 1944) and with greater structural detail (April 19th, 1945), but we are now able to give a general picture of the latest Firefly, the Mk IV, which has been the subject of quite a number of modifications.

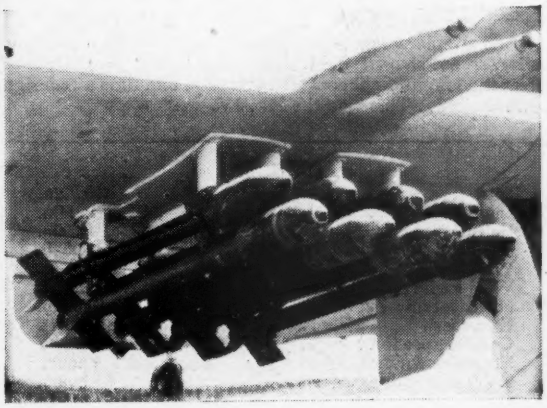
The most striking changes are concerned with the forward part of the aircraft, the original rather bulbous chin radiator having given way to a beautifully smooth cowling; the radiators have been placed in the leading edge of the wing centre section. This measure will undoubtedly enhance the aerodynamic cleanliness of the aircraft. Equally, we imagine, it will make the radiators far more vulnerable; however, this aspect of the matter has almost certainly been well thrashed out and it has apparently been thought worth while to risk increased vulnerability in order to obtain extra performance through the reduction of drag.

Wing-form, in plan, has undergone a radical change through clipping of the tips and the presence of the centre-section radiator projections. The departure from the elliptical character of the wings leads to an increase in manœuvrability, which quality the Firefly possessed to a quite considerable degree even in its original state. Again, the reduction of span will have no detrimental effect on the machine as it is not intended for high-altitude work.

It will be remembered from the original descriptions that the main fuel tank is carried in the fuselage between the pilot's and observer's cockpits, and that additional tankage was provided in the centre-section leading edges. The latter have, of course, been deleted in favour of the radiators, and consequently any extra tankage above normal has to be provided by external drop tanks, as shown in one of the accompanying photographs. This has given rise to a rather curious anomaly, for to balance the drop tank under the port wing, the special radar equipment which was normally carried in a streamlined fairing beneath the fuselage is now placed beneath the starboard wing in a complementary position to the tank; thus, when flying without the drop tank the drag will be asymmetric. However, we have it on the authority of a Firefly pilot that resulting change in trim is very slight.



Ninety-gallon drop tank and single bank of 60 lb. rockets on zero-length rails.



Eight 60 lb. rockets on the special double bank, zero - length projectors constitute a formidable armament.

Directional stability has been improved by a modification of the fin to give increased area by extending the chord forward and fitting a dorsal fairing. The actual increase in fin area appears to be slight, but æsthetically the new fin is rather more pleasing than the original.

A Rotol four-blade airscrew is used in conjunction with the Rolls-Royce Griffon 72 engine which gives 2,300 h.p. at 14,000ft. However, the Griffon 74 incorporating the new Rolls-Royce fuel injection pump (mentioned in the review of the Griffon, *Flight*, September 20th) is to go into the production version.

The nose of the power plant is extremely neat and much work has been done in obtaining a really clear under-belly to blend with wing root grooves. The four-blade Rotol airscrew is provided with a more pointed spanner consistent

FIREFLY IV

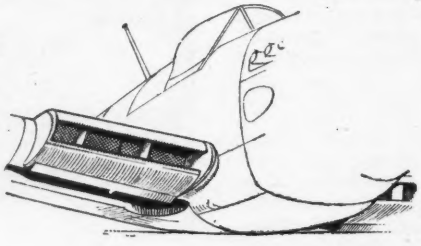
with improved performance. A forward-facing air intake is made integral with the "one-piece" bottom cowl, and an ice guard is fitted a few inches from the entry. Air cleaning is achieved by closing a pneumatically operated flap which shuts off the ram and causes the air to be sucked through internal louvres in the under-surface to obtain primary cleaning and then through a large-area Vokes cleaner to complete the process. The cleaner is positioned so as to cause no obstruction in the air intake duct when out of circuit.

The selection of "chassis down" is arranged automatically to bring the filter system into operation. Warm air from inside the power plant may be selected at will. Among other clean-up changes, the blisters over the guns have been reshaped.

By a simple attachment of an alternative exhaust trough, an interchangeable side panel complete with flame-damping shroud may be quickly fitted, or a glare shield for night work may be attached by two or three bolts. To facilitate engine servicing, the cowling support structure rails are incorporated in the cowl panels.

Thermostat Cooling Control

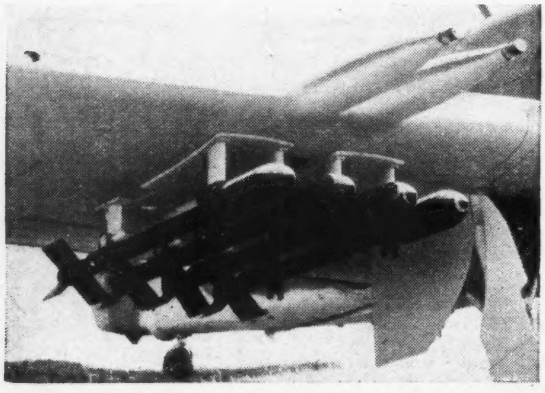
Cooling is controlled by mechanically interconnected all-metal flaps in the exit ducts. By means of a thermostat, the duct apertures are continuously adjusted, and thus steady engine temperatures are maintained. Cabin and gun heating is ducted from the forward side, with individual controls in each of the cockpits. Special effort has been made to obtain a maximum duct efficiency by using chordwise lips and grooves at the fuselage sides. Access to the radiators is gained by the removal of one large panel; when necessary, the whole unit may be lifted out by slackening the holding-down bolts and slinging at the two eyes provided. All piping and flap controls are accessible through the same opening.



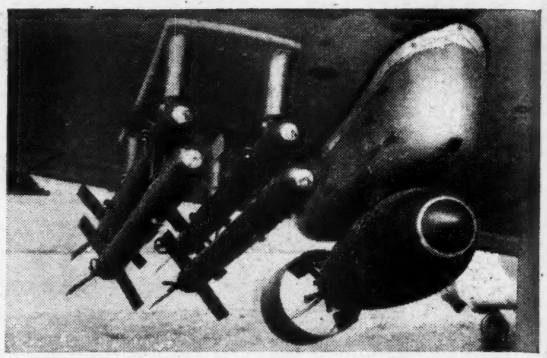
Wing radiators are used in the new Fairey Firefly IV.

Top speed of the Firefly IV is 386 m.p.h. at 14,000ft., which is some 70 m.p.h. quicker than the Mk. I, and approximately 8-10 m.p.h. of the 70 has been attained by the high-gloss surface finish in place of the matt surface used on the first machine. At 220 m.p.h. the aircraft has a high cruising speed, which is coupled with a range of four hours when using normal tankage; but range can be increased to 6½ hours by the extra drop tanks.

As with the Mk. I, the Firefly IV carries four 20 mm.



Four 60 lb. rockets in a single bank. In the leading edge (top left) is the automatic camera.



Doubled 25 lb. rockets and 500 lb. bomb on specially faired rack.

cannon, but according to tactical requirements it can, however, carry in addition 16 rockets, or eight heavy rockets, or bombs of various sizes up to 1,000 lb.—the maximum is two 1,000 lb. per aircraft—or long-range drop tanks which give a maximum range of 1,400 miles. Either tanks or bombs (but not both) can be carried on the same pick-ups and, extra to these, rockets can be carried as an additional overload. As shown in the accompanying photographs, the rockets are carried on the new-type "zero-length" rails, the front suspension incorporating a slip hook and the rear a short fore-and-aft slot into which fit extension lips from the rocket tube. This arrangement, whilst having the advantages of less weight and less drag, also permits the carrying of eight rockets per wing in two banks of four each, the lower bank being suspended from the upper in much the same fashion as the upper bank are suspended from the carriers. Sixteen 60 lb. rockets is a very formidable attack armament for any aircraft even without consideration of the four 20 mm. cannon which the Firefly can still use when its rockets are expended.

Not unexpectedly, during the secrecy of war, confusion has arisen concerning the various Firefly mark numbers. To clarify this, it may be explained that the modern Firefly I represented a day fighter (DF) version, and the Mk. II was designed as a night fighter (NF), incorporating an early type of radar. To give better stability for the NF version, the engine was moved forward 18in. But then came an improved radar, and this new equipment, it was found, could be installed in the Mk. I, which could thus be used for both DF and NF duties. Hence, the Mk. II was replaced by the Mk. I, with a Griffon XII.

In order to take advantage of improvements in the Griffon engine, the Firefly Mk. III was designed. This had an orthodox underslung nose radiator, installed in a bulbous and crescent-shaped duct. But this design appeared to affect the longitudinal control adversely, and thus a redesign was required. This was the Mk. IV.

FIREFLY IV

Span	41ft. 2in.
Length	37ft. 11in.
Height	14ft. 4in.
Weight	13,200 lb.
Wing area	330 sq. ft.
Wing loading	40 lb/sq. ft.
Power loading	5·73 lb/b.h.p.
Max. speed	386 m.p.h. @ 14,000ft.
Cruising speed	220 m.p.h. @ 14,000ft.
Normal endurance	4 hours.
Endurance with extra tanks	6½ hours.

North Pacific Economics

World Key Route Awaiting Exploitation : Great-Circle Course from Singapore to Vancouver

By E. T. HOUSE

OTHER things being equal, the three essential elements of economic, long-distance air transport are : First, the route distance between terminals must be as short as practicable. Secondly, the intermediate stages must be of such a length as to permit maximum aircraft stowage capacity to be used but, at the same time, of sufficient length to allow reasonable economy of aircraft performance. Thirdly, there must be populations and production areas at each terminal and along the route. These only can produce and demand the necessary paying load in sufficient quantity.

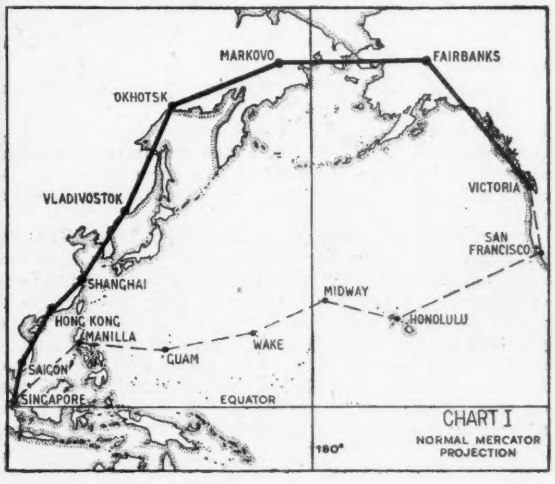
In this light let us consider the North Pacific ocean area, in which there has been little development of civil air transport except by the Americans.

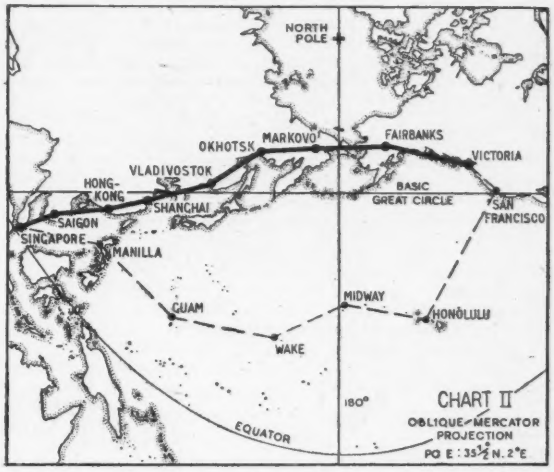
The main air link between Asia and the Americas has always, in the past, been via the key islands of the Pacific under American auspices. Guam, Wake, Midway and the Friendly Islands have been natural rafts in a vast expanse of water. Detailed investigation of the matter suggests, however, that this urge for hopping from island to island across the Pacific is enjoyed only by those who have not seriously considered the practical economy of air transport in that area. Alternatively, their governments may have neglected to practise the art of diplomacy so that other routes are politically barred.

The trans-Pacific island route fulfils none of the requirements set out in the first paragraph, and an additional reason for its popularity may well be the common use of maps based on the standard Mercator projection. Up to the present, of course, war conditions have prevented the use of any alternative. Even before the war, if consideration were given to a means of flying from, say, China to the U.S.A., pictures of attractive, tropical atolls immediately set themselves before the eyes of any promoter so that he became blinded to the cold vision of great-circle routes.

Mercator's Deception

On a standard Mercator map it appears only too obvious, to those not fully cognisant of the vagaries of projections, that the shortest distance between the Eastern and Western bulwarks of British influence in the Pacific, the Malay States and Canada, is via that convenient string of islands which stretch out across the ocean Eastwards from Asia and terminate in Hawaii. (This discussion, incidentally, is confined to that area of the Pacific north of the Equator and consequently Australasia does not come within its scope.) The enormous distortion caused by Mercator's projection is all too easily overlooked because the map, with its parallel lines of longitude, has a deceptive appearance of straightforwardness and reliability. Similarly, it appears that the available stopping places are fairly evenly spaced and even reasonably close together, when compared with alternatives in latitudes farther north. It is not easy to assimilate that the stage between Hawaii and America is 2,400 statute miles in length and is one of the longest stages to be regularly flown anywhere in the world.





The fallibility of the old Mercator map may be conveniently illustrated by making use of a new oblique Mercator projection, produced in 1942 by the late Mr. A. R. Hinks, of the Royal Geographical Society. Chart I shows a map of the North Pacific area according to the standard Mercator system. Chart II shows the same area produced by means of the oblique method, having as its central axis a great circle whose pole is 35½ deg. N., 2 deg. E. It will be seen at a glance that the great-circle course between Singapore and Vancouver runs along the coast of Eastern Asia, over the Northern shoulder of the globe a little south of the Aleutians and almost along the West Coast of the American continent. The island route via Hawaii is at once put into its correct perspective and is seen in its reality as a straggling curve lying far off the direct line.

The comparison may be conveniently set out as follows, taking an actual route along the coasts of Asia and North America as near to the great circle as possible.

Continental Route	Statute Miles	Island Route	Statute Miles
Singapore		Singapore	
Saigon	685	Manila	1,505
Hong Kong	935	Guam	1,595
Shanghai	760	Wake I.	1,510
Vladivostok	1,005	Midway I.	1,190
Okhotsk	1,245	Honolulu	1,305
Markovo	915	San Francisco	2,400
Fairbanks	1,230	Vancouver	800
Vancouver	1,370		
Total ...	= 8,145	Total ...	= 10,305

NORTH PACIFIC ECONOMICS

Thus the continental route is shorter by some 2,160 miles and, at the same time, offers a much safer journey, as the longest sea crossing is less than 100 miles. The fact that the travelling time would be about 9 hours less would have an important bearing on the views of prospective passengers.

A comparison can now be made between these two routes, envisaging the type of aircraft that is expected to be generally available for immediate post-war operations. Operational data might well be somewhat as follows :—

Take-off weight	85,000 lb.
Four engines each with max. power for take-off of	2,000 b.h.p.
Normal economic cruising consumption on approx. 33 per cent. power (650 b.h.p. per engine)	0.48 lb./b.h.p. hour.
Petrol tankage	2,800 imp. galls.
Still-air range (no reserve)	4,000 statute miles.
Still-air cruising speed on economic power at whatever altitude most suitable	250 m.p.h.
Empty weight	55,000 lb.
Allowance for crew, food, papers and minor equipment	2,350 lb.
Weight of oil	1,000 lb.
Payload for 1,370 miles	16,000 lb. with 1,500 gals. petrol.
Payload for 2,400 miles	9,000 lb. with 2,500 gals. petrol.

A convenient basis for comparing approximate costs is the rate of flying hours scheduled a year. Assuming that two services a day are operated in each direction on each route, the total flying hours per annum for the Island route would be approximately 67,000,* while those for the Continental route would be 53,400† only, i.e., 13,600 hours a year less or equivalent to a reduction of 20 per cent.

If the first element of economic air transport then be applied to these two routes, it will be seen that considerable economies result from the use of the continental route.

Cost Comparison

First, the saving in initial capital outlay will be large, as there will be required less aircraft, less spares, a smaller base with less capacious hangar accommodation and smaller workshops, etc. Secondly, the proportionate saving in running costs will be almost as great. There will be less petrol and oil consumed, fewer flight crews and maintenance staff employed and fewer engine, airscrew and component changes, resulting in lower maintenance and overhaul costs.

Because of the use of an additional station and the greater passenger accommodation provided, there will be slightly higher expenses for ground operations and equipment, passengers' services, sales and advertising expenses. These are, however, very minor items compared with the main expenditure and may be ignored for the purposes of this comparison. The use of this extra station will also result in 1,460 additional landings and take-offs a year. These will increase the maintenance work to a certain extent, but not sufficiently to approach that on the island route caused by the greater number of hours flown a year.

Allowances for depreciation of continental route equipment will be lower since there is less equipment involved. General administrative expenses may be expected to be much the same.

To illustrate the lower capital outlay required it will be assumed that maintenance facilities will permit the aircraft on both routes to operate at the rate of 3,000 hours each per annum. Thus a fleet of 18 aircraft only would be required, compared with 23 for the island route, to operate the same frequency of services. Since aircraft of the size under consideration, and in the numbers concerned, cost in the region of £1 sterling per pound weight, the saving in the total cost of the fleet would be about £425,000.

Similarly, the number of spare complete engine units required might be taken as 30, allowing 16 spares at base to cover overhauls, one at each station and 25 per cent. reserve. On the same basis 37 would be required for the island route (20 spare and 7 on the route, plus 25 per cent). The purchase of the smaller number of engines would decrease expenditure by some £12,000 to £15,000.

Running costs would be equally advantageous on the continental route. For example, two million gallons less petrol a year would be used and, assuming the average cost of 100-octane aviation petrol to be 2s. a gallon, there would be a saving of £200,000 a year.

Nine hundred flying hours annually per flight crew is a customary peace-time standard. This has been found, on overseas routes, to result in a low sickness factor. At this rate only 60 crews would be required against 75 for the island route, a saving of 15 complete flight crews. Assuming each crew to number 8‡, and the combined salaries of each crew to total £3,650 a year, the annual expenses would be £58,500 less.

Engine Costs

The number of engine overhauls required a year would be only 432 on the continental route as compared with 536 on the alternative, assuming each engine receives a complete overhaul every 500 running hours.

With a mean cost per engine overhaul of perhaps £100, allowing for labour, replacement of faulty parts and running-in and check tests, the saving on the continental route would be £10,400 per annum.

Thus, if every aspect of comparative costs were studied, it seems probable that the use of the continental route would require about 15 to 20 per cent. less initial capital outlay and would cost perhaps 10 to 15 per cent. less to operate.

If the second element of economic air transport now be considered, the advantages obtained by the use of the continental route are very great indeed. This route provides for a through capacity for pay load, for each service, of 16,000 lb. as compared with 9,000 lb. on the island route. The key stage, from Fairbanks to Vancouver of 1,370 statute miles, is 1,030 miles shorter than the very long counterpart on the Trans-Pacific route from Honolulu to San Francisco. No consideration is being given in this article to the intermediate loads offering. They would be likely to be heavy on the continental route and practically non-existent on the island route and thus, if included, would serve only to paint an even brighter picture of the former.

Let it now be assumed that on both routes the weight of passengers and cargo is evenly divided between the through capacities available. The maximum number of passengers and the maximum amount of cargo then carried on the respective routes in a year, in each direction, would be :

Continental ..	29,200 passengers	plus	5,840,000 lb. cargo.
Island	12,775 ,,	,,	2,355,000 lb. ,,

In practice the load factor rarely exceeds 90/95 per cent., even over the key stages of long-distance inter-continental services, but for the purposes of this argument it will be assumed that a 100 per cent. load factor is maintained throughout the year.

If commercial rates, on both routes, were 2½*d.* per passenger mile and 2*s.* per cargo ton mile (based on pre-war rates and probably quite reasonable for immediate post-war operations; in practice, of course, they would depend partly on actual costs) annual gross revenues would be provided of £8¾ million for the Continental route and £5 million for the island route. No allowance has been made for the possibility of a sliding scale for commercial rates, or some other form of charging, as it would become unnecessarily complex for this discussion. Thus the former

* Allowing a mean ground speed on all stages of 240 m.p.h. + 5 per cent. for dead flying.

† Allowing a mean ground speed on all stages of 235 m.p.h. + 5 per cent. for dead flying.

‡ First Pilot, £1,000 p.a.; Second Pilot, £800; Navigating Officer, £500; Radio Officer, £500; Engineer Officer, £500; Purser, £350, and two stewards, £250 each.

would have an additional earning capacity of some £3¾ million a year for a 10/20 per cent lower output of work.

In practice, however, matters would be even less satisfactory for a company operating on the island route. Due to the extra 2,160 route miles, the resultant traffic rates, terminal to terminal, would be about 25 per cent. higher, the basis for the comparative rates being taken on a similar charge per passenger/cargo-ton mile for both routes. The single fare for a passenger from Singapore to Vancouver, therefore, would be £107 as compared with only £85 on the continental route. Thus, if the island route company wished to compete seriously for through traffic with a company operating over the shorter route, it would have to lower its commercial rates per mile by about 20 per cent. This would reduce its gross annual revenue by £1 million to £4 million.

Alternatively, this former company might increase its commercial rates per mile in an effort to increase its revenue. In practice, however, the load would automatically offer itself to the route having the cheaper rate, particularly as this route would also be quicker and safer. Even if there were no continental competition, the island route commercial rates would have to be raised to 4½*d.* per passenger mile and 3*s.* 6*d.* per cargo ton/mile before achieving an annual gross revenue equal to that which would be obtained on the former route. Even then profits would be lower, due to the greater initial outlay and running expenses. Thus rates would have to be increased to 5½*d.* per passenger mile and 4*s.* per cargo ton/mile to attain profits equal to those of a service operating on the continental route. Such rates could, of course, be maintained only if a complete monopoly existed and competition on the continental route were non-existent.

NORTH PACIFIC ECONOMICS (CONTINUED)

Area Population

Finally, consideration must be given to the comparative load production areas along each route. There will be little disagreement with the statements—

(1) that in normal circumstances, and other things being equal, the density of air traffic flow is dependent on area population and the distance between any given areas.*

(2) that, provided international controls offer few restrictions (as may be expected in the future) the number of passengers carried by air is roughly proportional to the product of the two populations and inversely proportional to the distance between them.*

Similarly, provided trade restrictions are not overpowering and relationships are friendly, the volume of air freight between areas may be taken as roughly proportional to the product of the values of manufacturing and agricultural or raw material outputs of any given areas and inversely proportional to the distance between them.

Both routes have, of course, the same terminal areas covering Malaya and Canada and both Vancouver and Singapore are great exporting and distributing centres. The island route, it is true, schedules a call at San Francisco in the U.S.A. and thereby taps a mighty source of revenue. It would, however, be slightly cheaper to carry loads from San Francisco to Singapore or China by an extension from Vancouver and via the continental route, based on a direct mileage charge. Thus the fact that the U.S.A. is directly on the island route provides no advantage.

Even assuming America's "Five Freedoms of the Air," produced at the Chicago Conference, are generally accepted, there is comparatively little pressure for load to and from Hawaii, Wake, Midway and Guam Islands and the Philippines. In any case the last is nearer both Canada and America via the continental route, and any loads offering might advantageously be carried by a branch of this route.

The total population of all these islands amounts to only some 12¼ million, of whom 99.5 per cent. live in the Philippines. Production of raw materials and manufactured articles is also negligible.

On the continental route, however, lies China, that great hive of human industry. With the largest population in the world that lives, more or less, under one political control, numbering some 450/500 millions, and with a peace-time total annual income equal to that of the British Isles,† China offers one of the greatest opportunities for economic development in the world. China will ultimately become the dominant factor in Far-East economic matters, and air routes passing through will automatically be well supplied with load.

Additional great areas of production along the continental route, particularly of raw materials, are Indo-China, Eastern Siberia and Alaska, vast countries ripe for a development that can be greatly aided by aviation.

The East Indies area seems likely to become a vital junction in Western Pacific air transport as it has been for years in sea transport. Much of the load to and from Australasia and the Americas is likely to be directed to the continental route owing to the greater capacities offering at probably a cheaper price. Thus Singapore is conveniently situated to maintain its position as key to the Far East, and it is to be hoped the British Government will not hesitate, now that the Eastern war has drawn to a close, to install adequate facilities at the earliest possible opportunity.

From the production and population aspect the continental route, in a straight line along the west, north and east coasts of the Pacific Ocean, stands out as one of the key routes of the world. Let Great Britain, with the aid of sound diplomacy and a full understanding of the problems involved, be the first to take advantage of it and the first to offer service.

* The theory behind this statement was evolved by Dr. E. Warner and presented in the thirty-first Wilbur Wright memorial lecture in 1943.

† Figures for years 1925 to 1934 from *The Conditions of Economic Progress* by Clark.

STANDING-BY FOR THE RECORD

BY the time these words appear the world's air speed record may or may not have been broken. At the time of going to press the team was still waiting at Manston for the weather—which, after the unsullied calm of a St. Luke's summer, suddenly reverted to normal with an exhibition of high and low pressures and every intermediate meteorological symptom except those which the Meteors required for their low-altitude two-way runs over the Herne Bay course; the conditions awaited were, first and foremost, absolutely bump-free air and, secondly, visibility of at least five miles.

This does not mean that the aircraft have been completely grounded during the past fortnight. Several test flights have been made and (just as in the far-off Schneider Trophy days), valuable lessons learned.

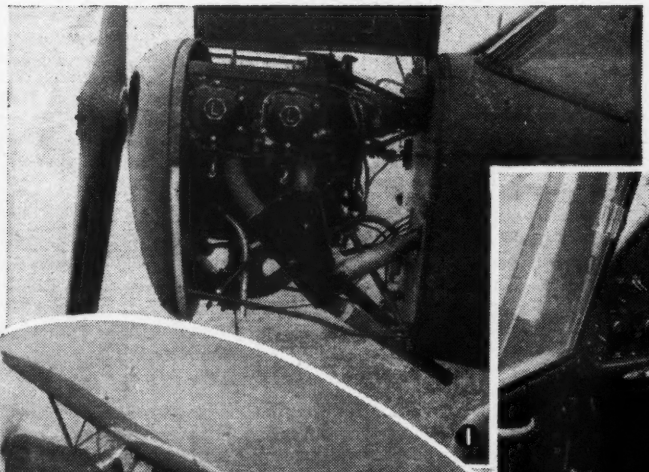
Both Meteors were taken over the course on Tuesday of last week in misty conditions and both, needless to say, handsomely exceeded the existing figure of 469.2 m.p.h. established by Wendel's Messerschmitt in 1939. Group Capt. Wilson, flying *Britannia* at altitude, did a single run at 590 m.p.h., and then came down for two more at a lower level, in opposite directions, of 601 and 609 m.p.h. Mr. Eric Greenwood, in the yellow machine, made three passes averaging 525 m.p.h.; in a fourth the mist put him off his course, and he was compelled to seek height hastily.

By some miscalculation—apparently human rather than mechanical—these figures were at first given out as being some 70 m.p.h. slower, causing a considerable amount of all-round mystification among the more knowledgeable participants and spectators.

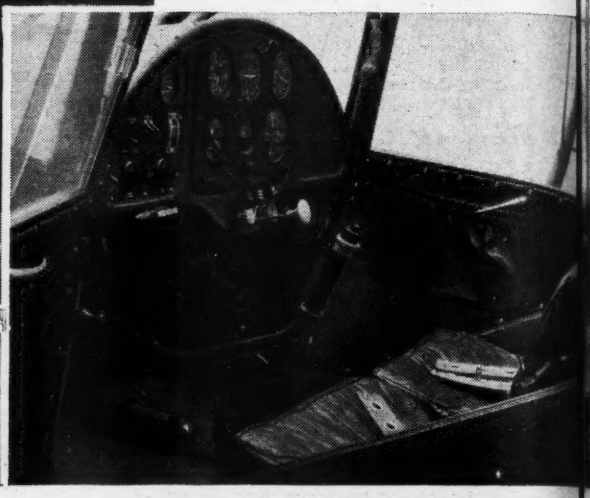
D

Taylorcraft Auster V

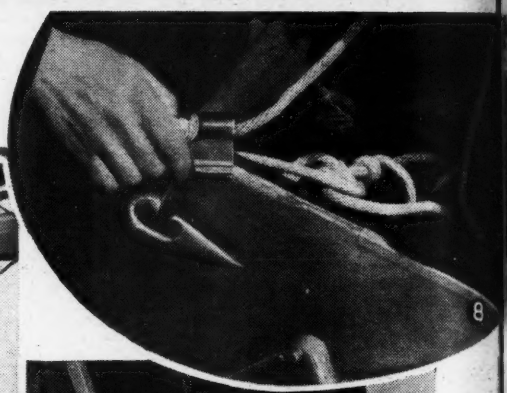
Amazing Versatility : A Low-powered Light Plane Equally at Home on Skis and Floats, Laying Telephone Cables and Picking Up Mail Bags

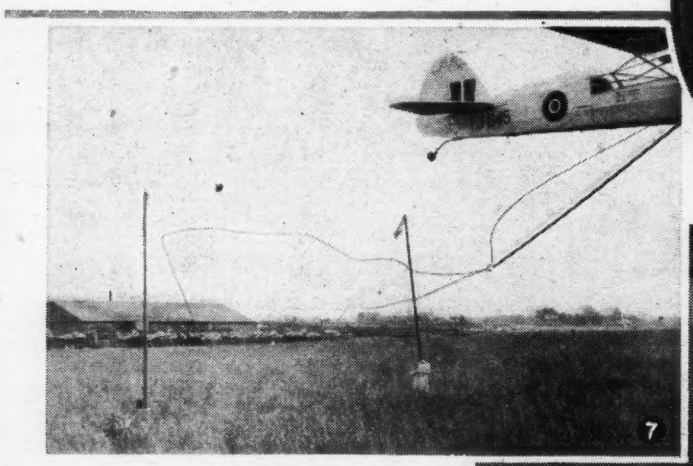


(1) The Lycoming engine is very accessible. (2) The standard Auster V. (3) The cockpit is equipped with full blind-flying panel, including artificial horizon and direction indicator.

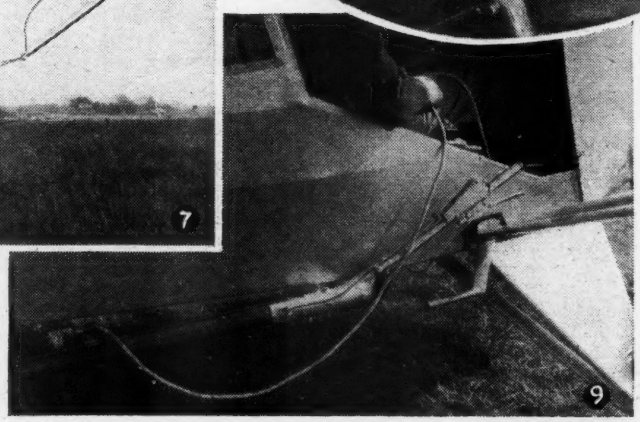


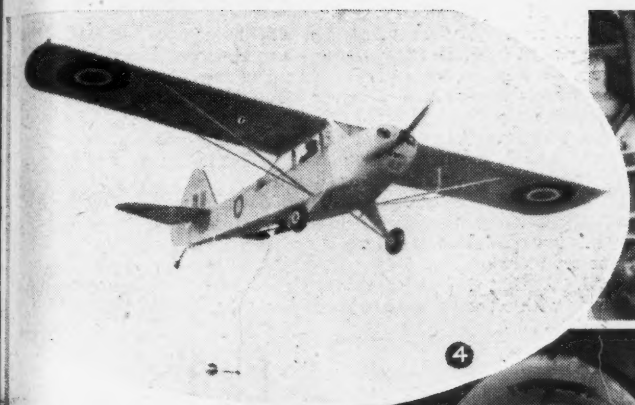
Below (7) an Auster V is seen at the moment of picking up a mailbag from two posts on the ground. The pilot climbs immediately contact has been made so as to avoid damage to the bag by trailing it along the ground. (8) The Nylon rope being attached to the hook.

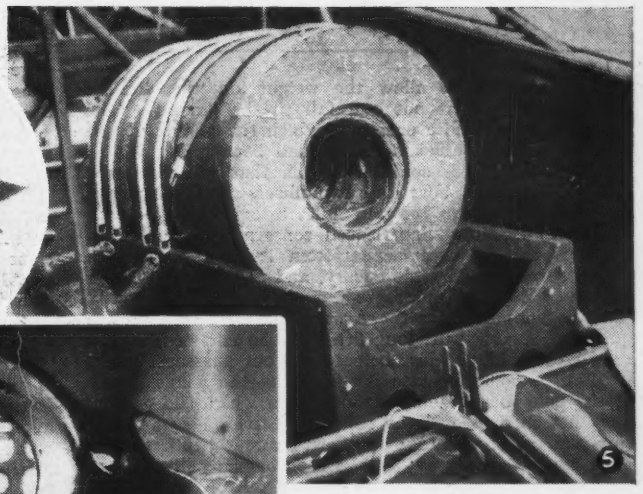


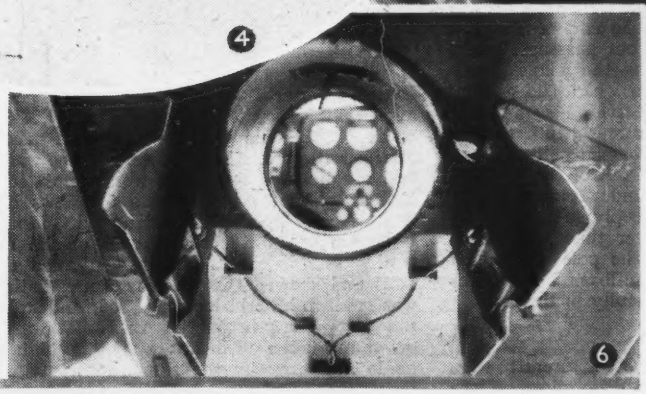


When the 15-ft. pole is lowered, the brass hook slides down the metal channel (9) which runs the full length of the pole. The pole is hinged immediately below the passenger's seat and operated from there.

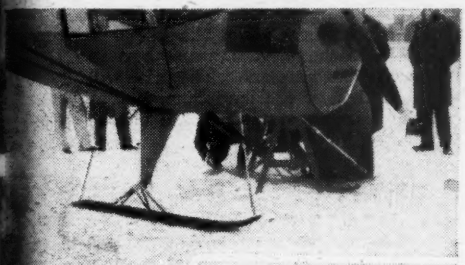






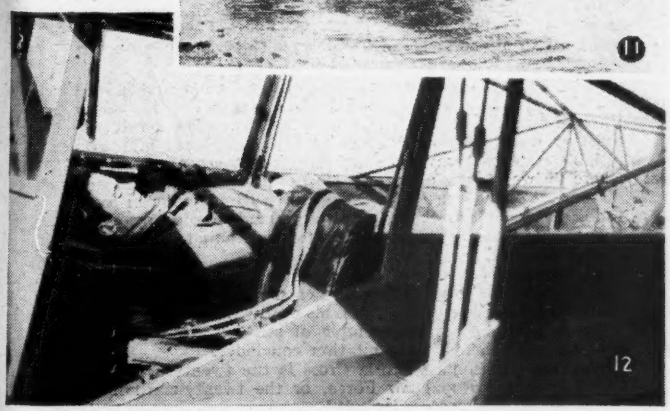


The Auster as a cable-layer (4) The telephone cable has just emerged and its free end is on its way down to the ground. (5) One of the four drums, each of which contains a mile of cable. (6) Looking up through the cable chute. A portion of the instrument pane is seen beyond.



Within a period of one week a set of skis (10) was designed, tested and ready for shipment to France. (11) An Auster V fitted with a pair of floats from a Queen Bee.

In spite of its small size, the Auster V can be used as an ambulance to take a stretcher case (12)



THE characteristics and career of the Taylorcraft Auster have been followed and recorded in these pages.* Initially a light plane designed for clubs and private ownership, it became a very useful Air Observation Post, and recently a civil version was announced. The military functions have, however, included tasks not hitherto mentioned. These were performed by the Mark V, which differs externally from the Mark IV only in the suppression of the tail-trimming vanes mounted under the tailplane. Their place has been taken by a more orthodox adjustable tab on the port elevator. This has been found to be more powerful in action, apart from providing a much neater installation. The engine is the same 130 h.p. Lycoming flat-four air-cooled type as that used in the Mark IV, and the maximum loaded weight remains at 1,700 lb. The fuel tank has been redesigned to give greater clearance for the full blind-flying panel.

One function of the Auster V which it shares with the Mark IV is ambulance work. The manner in which the seemingly impossible task of fitting a stretcher into the fuselage was achieved was explained and illustrated in our issue of April 20th, 1944. The machine has also been used for laying telephone cables and for picking up mailbags, and has been converted into a seaplane as well as fitted with skis in place of the wheels.

Aerial Cable Ship

During the jungle warfare in the Far East the laying of telephone cables was a slow and troublesome business, owing to the thick undergrowth. To the Signals Department was due the idea of laying the cables from an aircraft across the tops of the trees. The Auster, already doing excellent work in other ways, was chosen for the experiment, which proved a complete success. Four drums, each carrying one mile of telephone cable, were mounted in a cradle in the rear compartment. The ends of the cable were, of course, joined together. Two controls were provided for the pilot in the form of levers. One of these opened the

* Auster I and III, September 23rd, 1943. Auster IV, April 20th 1944. Civil Auster, October 18th, 1945.

TAYLORCRAFT AUSTER V

trap door so as to allow the weight on the end of the cable to pull it out and fall to the ground. The other lever operated a cutter by which the cable could be severed when a sufficient length had been laid. Simple as they were, these controls did all that was necessary and within a very short time two officers were speaking to one another through the four miles of cable.

Another difficulty experienced concerned getting messages through to headquarters from isolated pockets of troops surrounded by the enemy, and also letters to their homes. Picking-up messages was, of course, no novelty, but the equipment for the Austers had to be improvised quickly. A pole 15ft. long fitted to the underside of the fuselage was hinged just below the front passenger's seat so that he could operate it. Running the whole length of the pole was a metal channel down which slid a brass hook attached to a Nylon rope. The pilot flew low and slow across a ground rope stretched between two poles, the hook engaged this rope, and as soon as the pull came on the hook the Nylon rope was dragged out of the machine and trailed the mailbag along the ground. As soon as the contact was felt, the pilot climbed steeply so as to avoid damaging the mailbag. The passenger then hauled the rope and bag into the cockpit, and the pole was pulled up ready to collect the next bag. Mailbags weighing as much as 20 lb. were picked up successfully in this way.

Week-end Skis

In the early part of the year A.O.P. aircraft were grounded for considerable periods by deep snow on the Continent. Taylorcraft Aeroplanes were asked to get the machines into the air somehow. The request was received one Saturday, and on the following Monday morning a design for skis was prepared and submitted. By Wednesday of the same week the skis had been made and fitted, but darkness prevented a test flight that evening. The next morning, however, a flight was made and the skis were found satisfactory. On the Saturday, just a week after the receipt of the request, ten sets of skis were ready to be picked up at Rearsby and flown to France. The skis were made of wood and metal fittings, and the change-over from wheels to skis and vice versa could be carried out in a very short time.

It might have been thought that by now all possibilities of alternatives had been exhausted. This, however, was not the case. A demand arose for a light seaplane and Taylorcraft were entrusted with its development. The task must have appeared a pretty difficult one in view of the low power of the Lycoming engine, but the designers undertook it and tentative float designs were prepared. At that time, however, the works were in full production with standard models and time could not be found.

Ten-day Flotation

The alternative was the adaptation of an existing pair. It was found that those of a de Havilland Queen Bee radio-controlled aircraft might answer, and a pair was obtained and fitted. Flotation tests on a nearby N.F.S. water tank confirmed the trim calculations and the machine was ready for its water trials in ten days. These were fairly severe, and rough-water conditions were simulated by running a high-speed motor boat across the bows of the seaplane while it was taxying at high speed. Finally came complete air and water tests at an official marine aircraft testing establishment. These confirmed the preliminary tests and showed that the maximum indicated air speed was 126 m.p.h., cruising speed 108, and stalling speed with full flap 34 m.p.h. on the A.S.I. The machine was put down and taken off in waves 2ft. 6in. high. Modifications made necessary by the substitution of floats for wheels included the fitting of a self-starter for the engine and water rudders on the heels of the floats. Taylorcraft now have their own float designs, and it is hoped that the Auster V may one day be available to the private owner and to clubs as an inexpensive twin-float seaplane. The price will necessarily be higher than that of the landplane, but as this is very low even the seaplane version should not be unduly expensive.

Flight Engineer's V.C.

"Outstanding Gallantry" in Tackling a Fire in the Air

A FEAT which, for sheer desperate yet unflurried initiative in the face of overwhelming danger and difficulty, can seldom if ever have been equalled is marked by the award of the Victoria Cross to Sergeant (now Warrant Officer) Norman Cyril Jackson, R.A.F.V.R., of 106 Squadron.

Sgt. Jackson was flight engineer in a Lancaster which was hit by A.A fire when leaving the target area of Schweinfurt on the night of April 26th, 1944. A fire was started in a fuel tank between the fuselage and the starboard inner engine.

The citation relates how Jackson was thrown to the floor during the engagement. Wounds which he received from shell splinters in the right leg and shoulder were probably sustained at that time. Recovering himself, he remarked that he could deal with the fire on the wing and obtained his captain's permission to try to put out the flames.

Pushing a hand fire-extinguisher into the top of his life-saving jacket and clipping on his parachute pack, he jettisoned the escape hatch above the pilot's head. He then started to climb out of the cockpit and back along the top of the fuselage to the starboard wing. Before he could leave the fuselage his parachute pack opened and the whole canopy and rigging lines spilled into the cockpit.

Undeterred, Sgt. Jackson continued. The pilot, bomb-aimer and navigator gathered the parachute together and held on to the rigging lines, paying them out as the airman crawled aft. Eventually he slipped and, falling from the fuselage to the starboard wing, grasped an air intake on the leading edge of the wing. He succeeded in clinging on but lost the extinguisher, which was blown away.

W/O. N. C. Jackson.

By this time the fire had spread rapidly and Sgt. Jackson was involved. His face, hands and clothing were severely burnt. Unable to retain his hold, he was swept through the flames and over the trailing edge of the wing, dragging his parachute behind. When last seen it was only partly inflated and was burning in a number of places.

Realising that the fire could not be controlled, the captain gave the order to abandon aircraft. Four of the remaining members of the crew landed safely. The captain and rear gunner have not been accounted for.

Sgt. Jackson was unable to control his descent and landed heavily. He sustained a broken ankle, his right eye was closed through burns and his hands were useless. These injuries, together with the wounds received earlier, reduced him to a pitiable state. At daybreak he crawled to the nearest village, where he was taken prisoner. He bore the intense pain and discomfort of the journey to Dulag Luft with magnificent fortitude. After ten months in hospital he made a good recovery, though his hands require further treatment and are only of limited use.

"This airman's attempt to extinguish the fire and save the aircraft and crew from falling into enemy hands was an act of outstanding gallantry. . . . By his ready willingness to face these dangers he set an example of self-sacrifice which will ever be remembered," the citation concludes.

Sergeant Jackson's Victoria Cross is the twenty-first to be awarded in the Royal Air Force, or the twenty-sixth if the Dominion Air Forces are included.

HERE AND THERE

Gallant Squadrons

PAYING tribute to the Polish squadrons who fought with the R.A.F., Air Chief Marshal Sir Sholto Douglas, who returned to Germany last week after opening the R.A.F. Exhibition in Warsaw, said, "I pray that some means can be found, some honourable arrangement made, whereby the gallant squadrons can return to Poland with all the honour which is their due."

Air Chiefs at the Palace

FOUR newly appointed R.A.F. chiefs were received in audience by the King at Buckingham Palace last week.

They were Air Marshal Sir Arthur Conningham, C.-in-C. Flying Training Command; Air Marshal Sir Leonard Slatter, C.-in-C. Coastal Command; Air Marshal Sir Norman Bottomley, C.-in-C. Bomber Command; and Air Marshal Sir Leslie Hollinghurst, the new member of the Air Council, who was knighted and invested with the K.B.E.

Royal Visitor

QUEEN WILHELMINA of the Netherlands arrived in Britain in a Dakota operated by a Dutch airline when she paid a short visit to this country recently.

She flew from Falkenburg to Blackbushe airfield, where a R.A.F. guard of honour was formed, and she was greeted by the Netherlands Ambassador, Dr. E. Michiels Van Verduynen, Air Comdre. E. H. Fielden (representing R.A.F. Transport Command), and Grp. Capt. P. H. Maxwell, the C.O. of Blackbushe R.A.F. Station.

AEROVANGUARD : A Miles M.57 Aerovan, whose versatile characteristics fit it for many commercial roles from that of freighter to flying caravan, was recently demonstrated in France and Switzerland. Here it is at Le Bourget airport, Paris The type was described in *Flight*, June 7th.

Trooping by Air

A MIDDLE East military observer is quoted by Reuter's Cairo correspondent as mentioning the probability of a considerable extension of air trooping between Britain and the Far East. Adoption of projected large-scale plans, he said, would ensure more frequent leave for men serving abroad.

He was referring to a transit camp which has been laid out at Tel Litwinsky on a hill overlooking Lydda airport in Palestine and which can accommodate 2,000 passengers during a 48 hr. break in their journey.

"The Three Gs"

NEW YORK radio was quoted by Reuter last week for the report of three new types of flying bomb, brought out by the U.S. Navy, known as the Glomb, the Gordon and the Gargoyle.

The first is a 4,000 glider-bomb towed by a fighter and directed to its target, after casting off, by radio control. The second is a jet-propelled missile carried by a bomber and "beamed" against an enemy aircraft by radio control. And the third is a 1,000lb. jet-propelled armour-piercing flying bomb designed chiefly for use against ships.

U.S. Aircraft Production

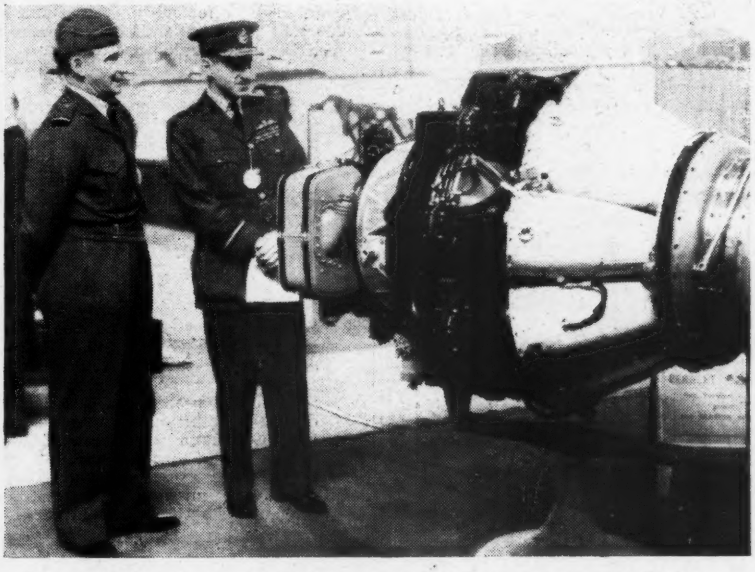
MR. J. A. KRUG, chairman of the U.S. War Production Board, has issued a report of America's wartime output, and in the section devoted to aircraft production he says that this represents a fleet of 297,000 military aircraft of which 97,000 were bombers, 99,000 fighters, 3,700 reconnaissance planes, 24,000 military transports, 58,000 trainers, 14,000 communication planes, and 2,000 special purpose aircraft.

Non-stop Switch to Peace

WHEN a war factory turns from fighters to frying-pans there is generally a hiatus in the process of changing over to the peacetime product, but a notable exception to this is the M.A.P. factory at Hillington, Glasgow, which has been operated by Rolls-Royce during the war.

One of the most impressive units at this great plant is the aluminium alloy foundry which supplied not only castings for its own Merlins, but those for the other Rolls-Royce factories and also for the Merlins made by Packards in America.

This foundry, said to be the largest and best equipped in Europe, has been acquired by the newly formed firm of Renfrew Foundries, Ltd., with which Col. W. C. Devereux (formerly of High Duty Alloys) and Rolls-Royce, Ltd., are associated, and there is to



V.I.P. : Besides referring to Marshals of the R.A.F. Lord Portal and Sir Arthur Tedder, the three familiar letters can also be applied to the Rolls Royce Derwent V jet engine (Vastly Improved Performance) they are inspecting at the Farnborough display of aircraft and ancillaries, reviewed elsewhere in this issue of *Flight*.

HERE AND THERE

be no break in the change-over to production of badly needed civilian goods. Already, in fact, such things as saucepans are appearing on the conveyors among the crankcases.

Town for Airport Workers

WITH the transfer of radio and meteorological personnel from the flying-boat station at Foynes to the Shannon land base (Rineanna) a new housing problem has been created as Rineanna is nine miles from the nearest town (Ennis).

To help solve the problem a new town is being planned at Ballycasey, three miles from the airport, for air station personnel. Ennis Council is undertaking the building of 138 houses in the district and will seek a Government grant of £50,000 for the building of others; a church and a cinema are also planned for the new town of Ballycasey.

"Parabox"

WE take the liberty of suggesting the above name for a device, recently evolved by the Forest Products Laboratory in America, which does the job of the small supply-container dropped by parachute. It is a fibreboard and plywood box 34in. long and 12in. square in section, to the sides of which are hinged rectangular rotors, or blades.

You just toss the box out of an aircraft and the blades open, limiting the rate of fall to a slow spin.

With a 50 lb. load it descends at about the same speed as a parachute container of the familiar type, but it is claimed that it has little or no drift, will not hang itself on trees, and will not be dragged along the ground. Moreover, it only costs $4 to make and can be turned out at the rate of nearly 1,000 an hour.

Protest

THE newly elected committee of management of the Aeronautical Engineers' Association is evidently not afraid to speak its mind, for one of the resolutions it passed at its first meeting, held recently at Wolverhampton, was bluntly critical of Air Ministry policy—or, should we say, alleged policy?

"This meeting," runs the resolution, "condemns most vigorously the policy of the Air Ministry in accepting the principle that only pre-1939 apprentice-trained men are skilled aircraft maintenance engineers . . ." and it goes on to accuse the A.M. of "permitting a system of favouritism in promotions and in merit-pay awards to operate at many of the civilian-staffed Maintenance Units of the R.A.F."

Another resolution recommended the use of present M.U.s for civil aviation.

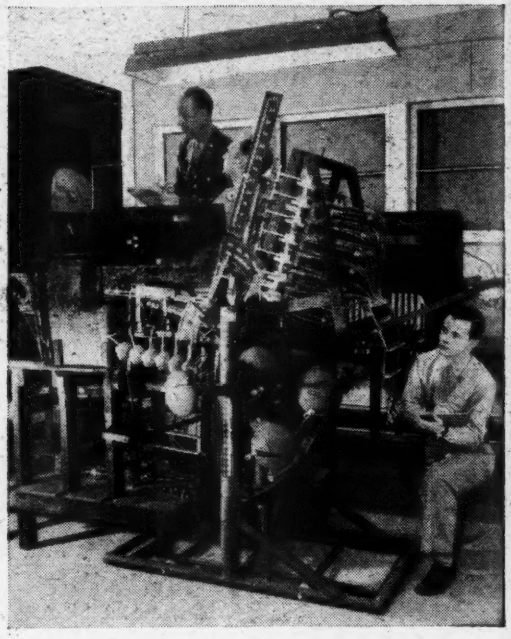
U.S. Naval Air Strength

THREE U.S. aircraft carriers of the 27,000-ton Essex class are to be "scrapped or relegated to museum status," according to a recent statement by the U.S. Information Service. They are the Saratogo, Ranger and Enterprise.

According to plans revealed recently by a U.S. Navy spokesman, the post-war U.S. Fleet will include 37 first-line carriers and 18 battleships.

Of the carriers, only ten will be held in battle commission — three of the 45,000-ton Midway class and seven of the smaller Essex class; the other 27 will be held in reserve.

The total of U.S. Navy aircraft will, says the report, be 11,680, of which 7,928 will be "operating aircraft."



YOU WANT THE BEST SEAT? Well, this elaborate test seat at the Aero-Medical Laboratory, Wright Field, finds it for the pilot.

News in Brief

A WING of the R.A.A.F. is being rearmed and equipped for service in Japan as part of the occupation forces. It comprises about 2,000 men and is being assembled in north-west Borneo.

* * *

Lord Swinton, former Minister of Civil Aviation, has been elected chairman of the Conservative Civil Aviation Committee. Mr. Lennox-Boyd is deputy chairman, and there are two secretaries—Sir Wavell Wakefield and Air Comdre. A. V. Harvey.

* * *

The number of workers employed in the aircraft industry at the end of August last was approximately 993,000, as compared with 1,700,000 at the end of August, 1944. Outstanding orders for all types of aircraft were 10,300 and 43,300 respectively.

"There's a bloke outside, sir, with something rather new in anti-G. suits."

Incendiary bombs, it was recently disclosed, were dropped in 1942 on forest lands in the north-western State of Oregon, U.S., by Japanese aircraft launched from submarines lying off the coast. They started a few fires which were quickly put out, and no material damage was done.

* * *

The Hon. David Bowes Lyon, a director of Martin's Bank, the Royal Exchange Assurance Co., and the Times Publishing Co., and a member of the firm of Edward de Stein and Co., has been appointed a director of the Dunlop Rubber Co., Ltd. Lord Colwyn has resigned from the Dunlop board.

* * *

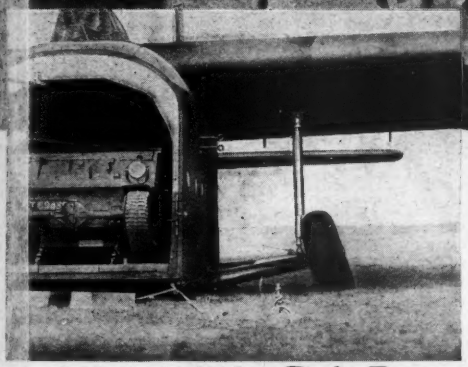
The Soviet Clipper flying-boat, built for the Russians by Glenn Martin in 1937, is still flying after nearly eight years' service as a patrol bomber and Red Navy transport. When a Russian freighter collected her at New York the flying-boat was equipped for luxurious passenger travel.

* * *

Wing Cdr. John Strachey, Under-Secretary for Air, in a written reply to Sir Ralph Glyn (Con., Abingdon), said last week that during the four weeks ended October 28th reports had been received of accidents to aircraft operating in Transport Command which caused the deaths of 46 passengers and 26 crew; three passengers and seven crew were missing, and 11 passengers and 15 crew were injured.

* * *

Mr. F. F. Crocombe, chief designer at General Aircraft, Ltd., since 1934, and Mr. H. V. Gort, the firm's secretary, have been elected directors of the company.



HAMILCAR

When, soon before D-day, it was found that skid-landing the Hamilcar made it difficult to manœuvre into convenient positions after landing, we were asked to help in the very short time available. In response to this S.O.S. we fitted the "Airdraulic" landing legs with valves, which slowly released the fluid when necessary, letting the machine down to the ground, and thus facilitating the unloading.

The fluid can be pumped back again prior to take off, a feature which will be valuable for freight planes of the future.

The photographs are reproduced by the courtesy of General Aircraft Ltd., designers of the "Hamilcar."

AUTOMOTIVE PRODUCTS COMPANY, LTD., LEAMINGTON SPA

HIGH PRECISION HYDRAULICS

Lockheed

Portraits from the Famous Pathfinder Force of Bomber Command

PATHFINDER GROUP

Wing Cdr. S. BAKER, D.S.O. and Bar, D.F.C. and Bar.

Wing Cdr. I. G. BROOM, D.S.O., D.F.C. and Two Bars.

Group Capt. H. E. BUFTON, D.S.O., D.F.C., A.F.C.

Sqn. Ldr. T. W. BLAIR, D.S.O., D.F.C. and Bar.

Group Capt. W. F. M. NEWSON, D.S.O., D.F.C. and Bar.

Wing Cdr. J. NORTHROP, D.S.O., D.F.C., A.F.C.

Wing Cdr. J. E. DENNANT, D.S.O., D.F.C.

Wing Cdr. B. G. D. NATHAN D.S.O.

(Left) Wing Cdr W. J. R. SHEPHERD, O.B.E.

Wing Cdr. MAURICE SMITH, D.F.C.

Wing Cdr. T. W. HORTON D.S.O., D.F.C. and Bar

(Right) Group Capt. R. W. P. COLLINGS, D.S.O., A.F.C.

Group Capt. S. P. COULSON. D.S.O., D.F.C.

(Left) Sqn. Ldr. N. BOWMAN, D.S.O., D.F.C.

(Above) Sqn. Ldr. D. P. D. ARCHER, D.F.C. and Bar, D.F.M.

(Above) Sqn. Ldr. E. E. RODLEY, D.S.O., D.F.C. and Bar, A.F.C.

(Left) Group Capt. McC. WHITE.

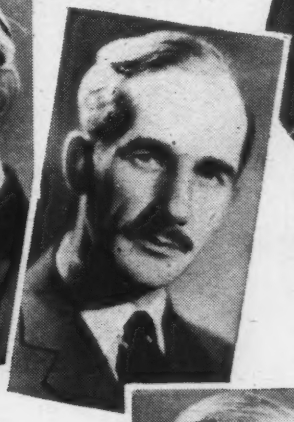
(Right) Sqn. Ldr. R. D. McLaren, D.F.C.

Group Capt. G. F. GRANT, D.S.O. and Bar, D.F.C.

(Below) Group Capt. R. W. COX, D.S.O., D.F.C., A.F.C.

Wing Cdr. R. J. BURROUGH, D.F.C.

(Below) Group Capt. LAURENCE CHARLES DEANE, D.S.O., D.F.C.



Wing Cdr. T. G. JEFFERSON, D.S.O., A.F.C.

Wing Cdr. I. C. ALABASTER, D.S.O. and Bar, D.F.C. and Bar.

(Left) Sqn. Ldr. V. G. ROBSON, D.F.C. and Bar.

Group Capt. K. J. SOMERVILLE, D.S.O., D.F.C., A.F.C.

Sqn. Ldr. G. W. O'DONOVAN, D.S.O., D.F.C.

Group Capt. P. H. CRIBB, D.S.O. and Bar, D.F.C.

Sqn. Ldr. J. B. BURT, D.S.O., D.F.C. and Bar.

(Left) Wing Cdr. R. C. E. LAW, D.S.O., D.F.C.

Flt. Lt. A. PEARSON, D.S.O., D.F.C.

(Left) Sqn Ldr. P. MAINS-SMITH D.S.O., D.F.C.

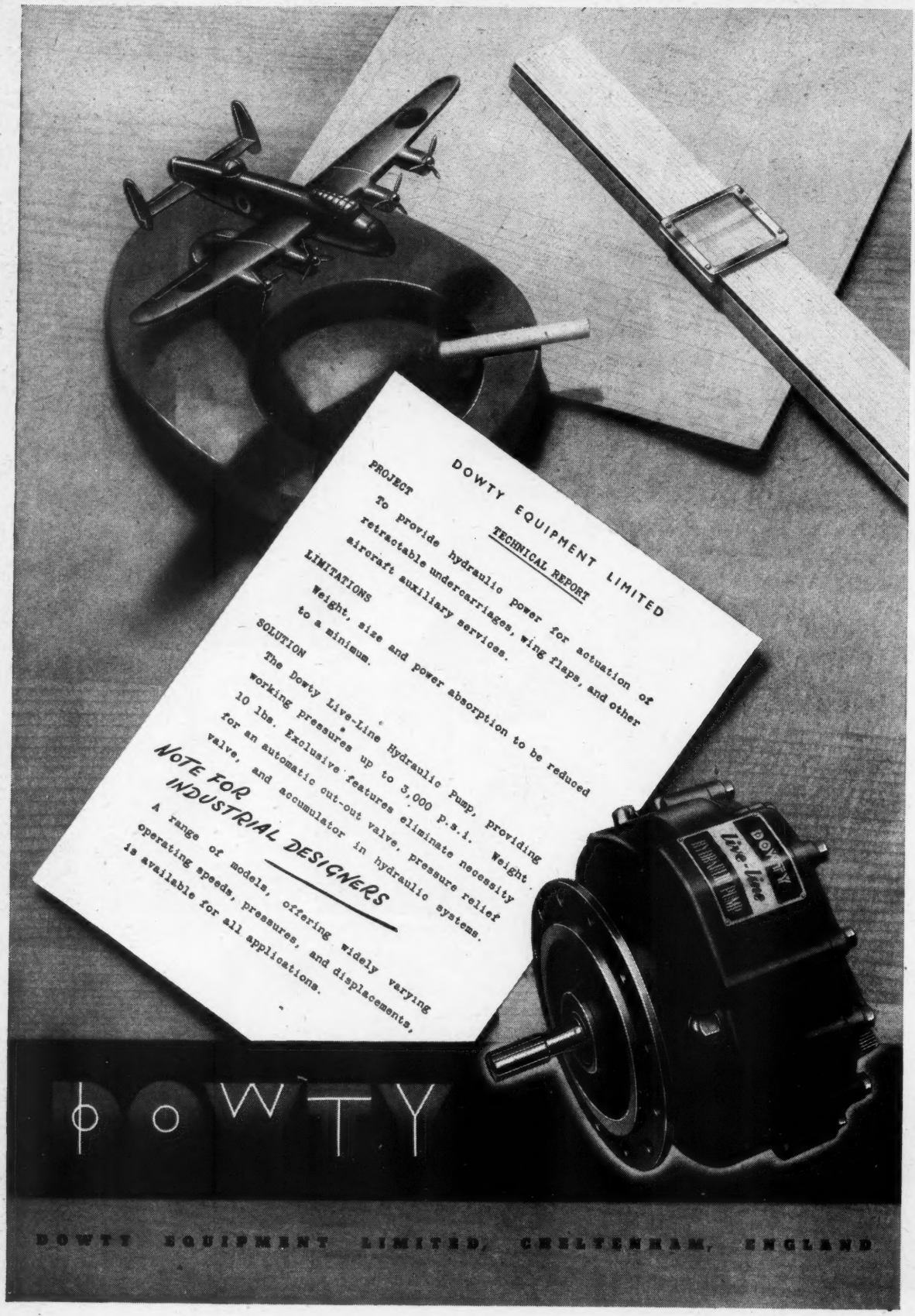
Wing Cdr. A. J. L. CRAIG, D.S.O., D.F.C.

(Above) Wing Cdr. D. F. E. C. DEAN, D.S.O., D.F.C. and Bar.

(Left) Flt. Lt. E. E. STOCKER, D.S.O., D.F.C.

(Right) Wing Cdr. H. P. CONNOLLY, D.F.C. and Bar, A.F.M.

(Above) Wing Cdr. J. R. G. RALSTON, D.S.O., and Bar, A.F.C., D.F.M. (Right) Group Capt. T. G. MAHADDIE, D.S.O., D.F.C., A.F.C.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SECRECY TO THE WINDS: Experimental and prototype aircraft lined up on the airfield at Farnborough.

Revelations at Farnborough

Britain's—and Germany's—Latest Aircraft and Engines Make Their First Public Appearance : Spectacular Demonstrations : Newest Jet Units on View

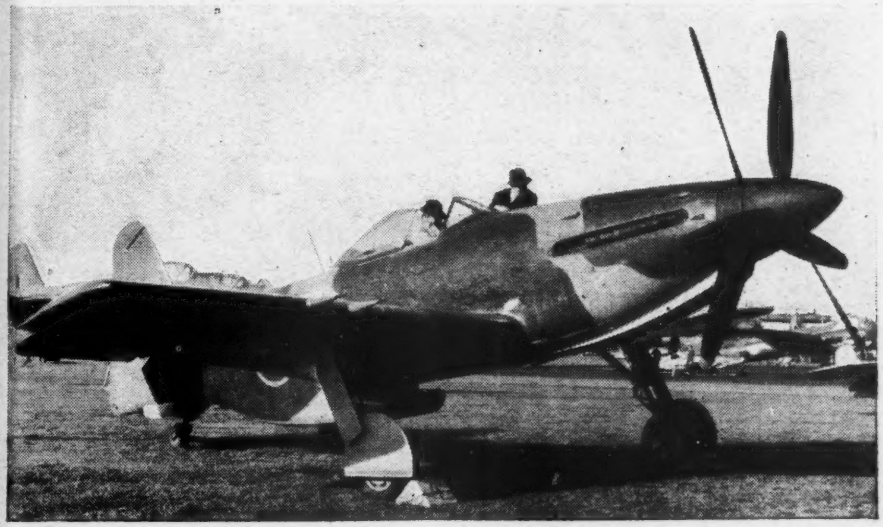
IN last week's issue we gave a brief picture of the Farnborough display of October 29, and now a more expanded description of the aircraft and engines at this comprehensive exhibition can be given. The extraordinarily wide scope of the display (given for the benefit of a "privileged" public) covered not only the latest British aircraft and engines, but also a very wide range of German aircraft, engines and ancillaries, while visitors were also permitted to view the various departments which make up the Royal Aircraft Establishment.

Necessarily, since the majority of the complete aircraft were parked in the open, the success of the day could not have been complete without the assistance of the Meteorological Office. In fact, after a most unpromising start, the weather cleared and enabled the organisers to run a most thorough flying display without a hitch.

Starting with bombers and civil transport types, this display continued throughout the afternoon almost until darkness fell while the various other types of military aircraft were shown off. The flying part of the programme was rounded off nicely when, after two German jet-propelled aircraft had been flown by Farnborough pilots, the Short Shetland was brought quietly over in the hands of a Felixstowe pilot. This civil flying boat had been due to arrive earlier in the programme, and we could only hope that there was still sufficient light for it to be put down comfortably at its base while the late visitors were still dispersing.

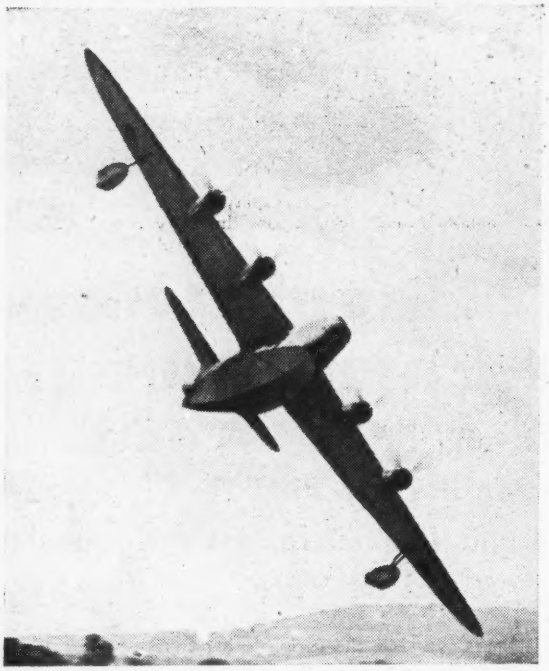
First off the runway in bright sunshine was the Halifax VIII transport which, with four Hercules 100 radials, can be used for a number of heavy duties. In its exhibited version this aircraft was fitted with a freight pannier slung under the bomb bay, giving the aircraft a somewhat Warwickesque appearance. This pannier can be replaced with extra tanks, when a range of more than 3,000 miles with 13 passengers and equipment is possible. At its standard 2,450-mile range with normal tanks, the Halifax will carry a freight load of about 8,000 lb. Although unrehearsed, Mr. Talbot's overshoot circuit gave an impressive demonstration of slow-speed controllability. After receiving a "red" he went round again, with undercarriage down, in a slow, tight, low-level circuit.

Avros were well represented by their long-



The features of the new Martin-Baker F18/39 are accessibility, simplicity and good view. It was the only aircraft on view with "contra props."

REVELATIONS AT FARNBOROUGH



The Short Shetland provided a dignified finale to the flying display. The Centaurus engines looked strangely small in the massive wing structure.

range Lancastrian, by a Mark II Lincoln and by a Tudor I flown respectively by Sqn. Ldrs. Cook and Field-Richards, and Mr. Thorne, the firm's chief test pilot. All three are fitted with the comparatively new "circular" tropicalised cowlings for the Merlin engines, and both the Lincoln and the Tudor had built-in leading-edge de-icing systems of the type in which wick-regulated glycol exudes under control from special leading-edge strips. An encouraging sight in these days of civil aviation depression, the Tudor has almost entirely lost its bomber ancestry.

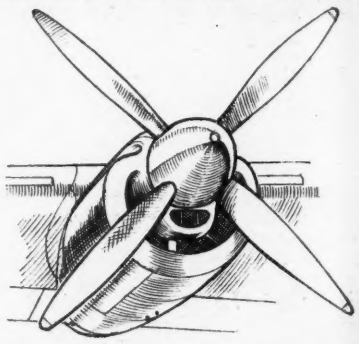
Experimentally interesting was the Vickers Windsor I. Though not likely, we feel, to go into production, this aircraft has probably been a useful flying test bed for several new ideas. By way of getting over some of the undercarriage and wing ground-loading difficulties, the Windsor has four single oleo legs, one under each engine nacelle, with a total track of 50ft. Like the Wellington, the structure is geodetic, with, as covering, a composite fabric material of woven steel wire base, with, in some areas, a glass-cloth backing. Spring servo-tabs are used on all controlled surfaces. It was interesting, in casual inspection, to realise at Farnborough how such spring-servo tabs, whether in "genuine" or torque tube form, were being used more and more in very fast or in "heavy control" aircraft.

Another of this country's promising new civil types to be seen was the Vickers Viking, a medium-range transport carrying a maximum payload of 7,000 lb. over a range of 1,000 miles at a cruising speed of 215 m.p.h. Both the Windsor and the Viking, flown by Messrs. Lucke and Handasyde, were taken off, after an initial tail-up run, in the rather exaggerated tail-down manner familiar to those who have flown lightly loaded Wellingtons—an effect ocularly increased by the naturally small ground angle of both types.

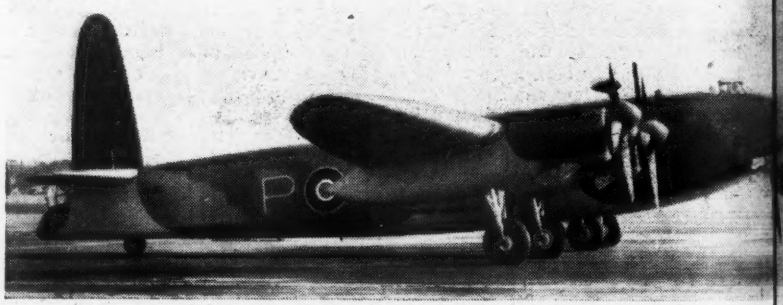
True Prototype

It seemed a trifle odd that, apart from the two jet aircraft, the only machine with a tricycle undercarriage to be seen amongst the British exhibits at Farnborough was the new de Havilland Dove. This "little airliner" is still in the course of its prototype development tests in the hands of Mr. Geoffrey Pike, who was flying the machine on this occasion.

First among the military aircraft to be flown was another de Havilland product, the Hornet I handled by Mr. Fillingham. The demonstration was all the more impressive since it followed the more sedate flights of the large aircraft, and inevitably included in the repertoire was a single-engined upward roll. It may be



"Circular" tropicalised cowlings for the Merlins were to be seen on all the Avro aircraft at Farnborough.

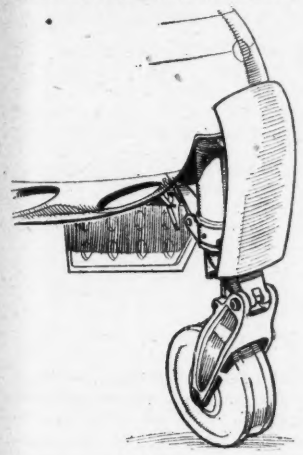


The experimental Vickers Windsor four-engined bomber has four separate undercarriage units, one under each engine nacelle.

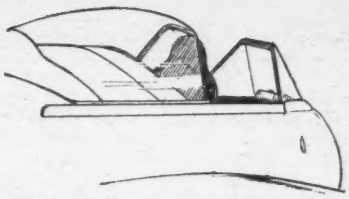
Straight from prototype development tests, the D.H. Dove was the newest aircraft at Farnborough.

remembered that the Hornet is a long-range single-seat fighter designed originally for work in the Pacific. Since its use from aircraft carriers was envisaged from the outset, the engine reduction gears were modified to give opposite airscrew rotation and thus reduce the effects of torque on take-off. Unlike the Mosquito, with its all-wood construction and slotted flaps, the Hornet is of composite construction and is fitted with split flaps. The top speed is better than 450 m.p.h. and the initial rate of climb of the 5,000 ft./min. order. The Mosquito in the display was one of the new Mark XXXIV P.R. types flown by Mr. Simmons, who, unable to improve on the Hornet's show, gave the spectators a good idea of its comparatively small high-speed turning circle.

Those who had not previously seen the now "standard" demonstration tactics of Mr. Geoffrey de Havilland with the Vampire I must have felt that this was very much the climax of the display. Even to us the demonstration has an evergreen quality, and proves once again that the Vampire has good, light aileron control and excellent fore-and-aft stability up to speeds of the 500 m.p.h. order. The "inside-the-airfield" turns were particularly impressive, and one wondered at the loads being personally withstood with or without a G-suit. Perhaps Mr. de Havilland is, so to speak, his own G-suit. The top speed of the Vampire has been given as 540 m.p.h.

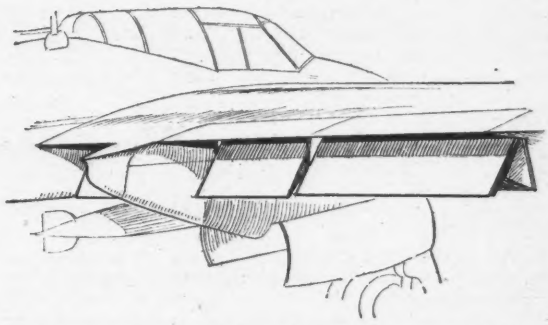


The nosewheel of the Vampire I, its anti-shimmy tyre and "doors."



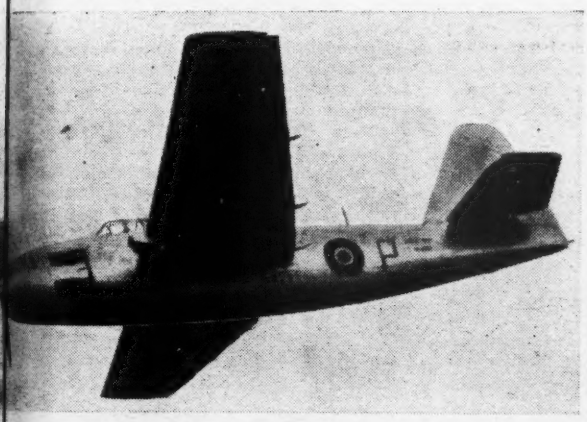
The D.H. Hornet's screen is optically unobstructed.

It is difficult to forget the fact that secrecy is no longer maintained where new types are concerned. A few weeks ago, at the Heston Naval Display, the Hawker Sea Fury was demonstrated—even before the Fury had been mentioned as a type. This fighter is something very much more than a development of the Tempest. The most noticeable exterior differences are a shortening of the span at the centre-section and considerable alterations to rudder shape. Spring tabs are used both for ailerons and rudder,



Typically high-drag are the flaps of the Bristol Brigand torpedo-bomber. One of the lower dive-flaps can be seen

and Mr. Humble gave the spectators a more than good idea of its high-speed manœuvrability and safe characteristics in tight low-level turns. The Fury has a Centaurus 18 engine and a Rotol five-bladed airscrew absorbs the power. The top speed is given at 470 m.p.h. From the spectators' point of view it was unfortunate that the now dated Tempest II and VI should have followed the new Fury and the even faster Vampire.



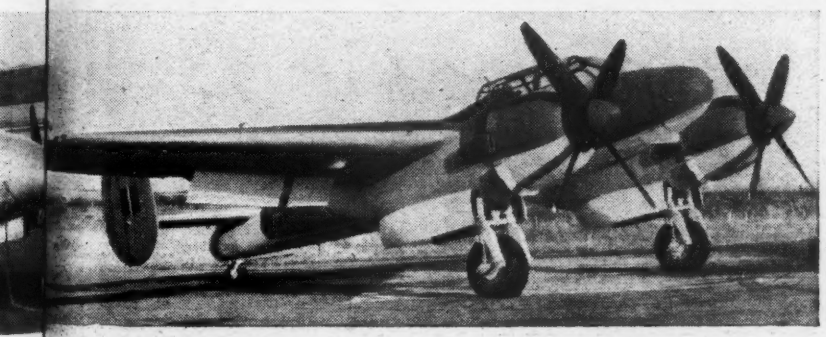
Mr. Dixon shows off the prototype Fairey Spearfish torpedo-bomber. The faired guides for the flaps can be seen.

Natural Contrast

The Gloster Meteor to be seen was the very latest Mark—the IV with the new type of lengthened jet unit nacelles to delay the incidence of compressibility effects. It has the higher-powered Derwent V engines and was flown on this occasion by Wing Cdr. R. Falk.

By way of contrast between speed and sheer utility, the Meteor was followed in the air by the Fairey Spearfish I, a prototype torpedo dive-bomber for the Fleet Air Arm. Mr. Dixon was unable, with the comparatively distant take-off point used, to demonstrate the effect of the very wide-span high-lift flaps and the acceleration, which is so great that the aircraft is in the air long before the throttle reaches take-off boost. After the demonstrations of very fast aircraft, the Spearfish's relatively high top speed of 270 knots could not be appreciated. As in the case of all modern naval aircraft, the wings of the Spearfish are power-folded. With long-range tanks the endurance is given as 1,650 nautical miles.

The new Firefly IV was flown with

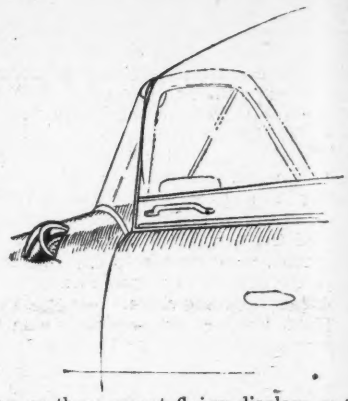


The Bristol Brigand was seen at Farnborough carrying a full complement of different projectiles—it is seen here in unarmed form.

REVELATIONS AT FARNBOROUGH

its long-range wing tanks and Mr. Evans showed that, even when so hampered, the IV is a very manœuvrable aircraft. The most obvious exterior difference between this and the first Mark of Firefly lies in the fact that the radiators are now placed in the leading edge, and it has a larger rudder area and clipped wings. The engine is a Griffon 74 and the maximum speed is 386 m.p.h. at 14,000ft. The official handbook gave this figure as 300 knots, with a rate of climb of 2,500ft./min.

Very multi-purpose in its demonstrated form was the Bristol Brigand I with dummy torpedo and rocket projectiles. Even with this full load the Brigand is expected to have a range of 2,200 miles when cruising at 200 m.p.h., while when using auxiliary fuel tanks this range can be extended by another 1,000 miles. The maximum speed at sea level is given at 350 m.p.h. As in the case of its forebears, the Brigand has an extraordinarily large area of split flap and the dive brakes are worked on the bellows system familiar in later marks of Beaufighter. As in the case of the Buckmaster and the Buckingham, power is provided by two Centaurus 57 engines. Mr. Pegg, who flew the machine at Farnborough, made successful efforts to demonstrate the lightness of the spring-tab controls at high speed.



For the benefit of the deck-landing pilot the Firebrand has an additional exterior A.S.I. so that he can watch both this and the batsman.

Already seen at two or three recent flying displays and described recently in *Flight*, the Blackburn Firebrand IV is an example of the new naval "attack" aircraft. It is still somewhat unusual to see a torpedo-carrying machine flying in anything differing much from a perfectly level attitude.

The remainder of the aircraft and static exhibits will be dealt with next week.

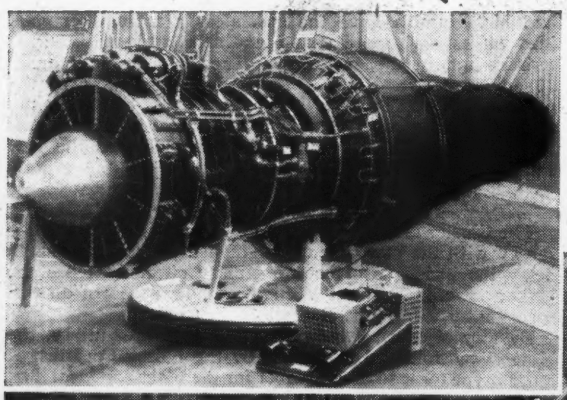
Power Units

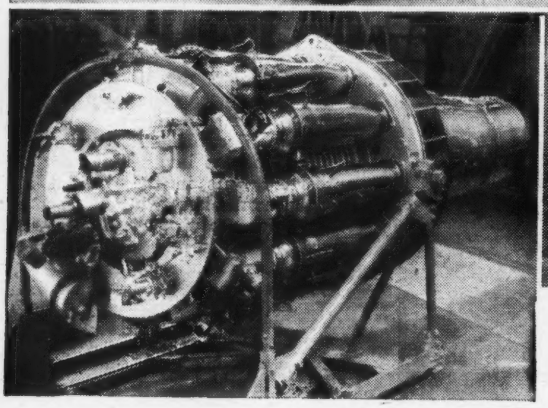
A Concourse of Jets : German Rocket Types

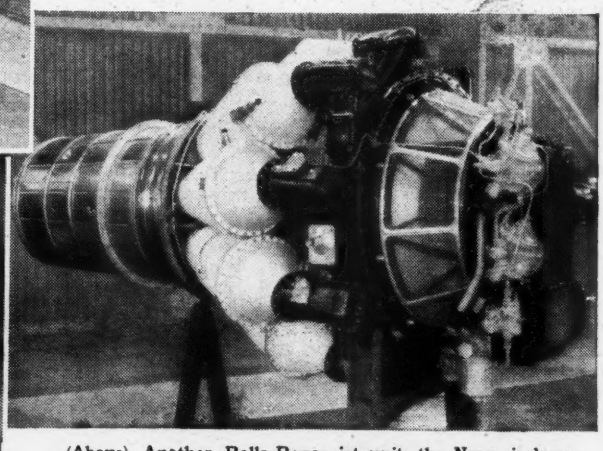
IT was inevitable that among the power jets on exhibition attention should be focused on turbine-jet engines. This was the first occasion on which a variety of British types had been displayed. Recent publicity had made the early Whittle units, the Rolls-Royce Derwent and the de Havilland Goblin relatively familiar, but a larger engine by Rolls-Royce and units employing axial-flow compressors by Armstrong Siddeley and Metropolitan-Vickers emphasised the rapidity of the development.

On the flying ground a similar interest in jet-propelled aircraft was observable, despite brilliant performances by new aircraft powered by orthodox types of engine. It was akin to the atmosphere at a sports meeting where a brilliant young athlete is competing with a number of older and more experienced record-holders. All the potentialities appear to be with the newcomer using the new technique, but the champions die hard.

Although the Rolls-Royce Nene was making its first "public" appearance it is not a completely new engine. It was designed and built in the short period of 5½ months and first run in October, 1944. Thus it is a parallel rather than a subsequent development of the Derwent, which it resembles in general features and layout. Like the later







(Above) Another Rolls-Royce jet unit, the Nene, is larger than the Derwent and develops a static thrust of 5,000lb. (Top left) This Metropolitan-Vickers jet engine was the first British axial compressor unit to fly. (Bottom left) The Armstrong-Siddeley jet engine has air intake at mid-position and combustion chambers round the axial compressor.

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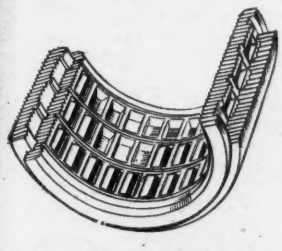
Derwent models it has nine straight-through combustion chambers. Designed initially for a thrust of 4,000 lb. at 12,300 r.p.m., it has a maximum diameter of 49½in. and an overall length of 97in., against 43in. and 88½in. respectively for the Derwent. Since its inception performance has been improved, and it is now cleared for flight with a maximum thrust of 5,000 lb. at 12,400 r.p.m. The dry weight of the unit is 1,600 lb. and the specific fuel consumption 1.08 lb./hr./lb. thrust. As mentioned last week the performance of the Lockheed Shooting Star was improved by substituting Nene engines for those normally fitted to this aircraft.

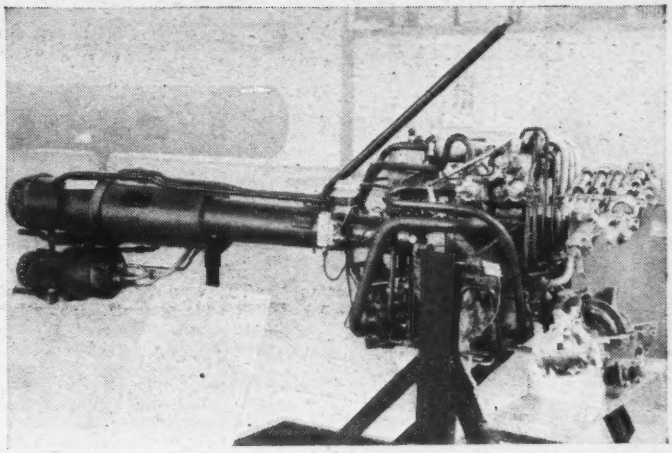
Metro-Vick Jet

A new entry to the field of manufacturers of aircraft propulsion units is the Metropolitan-Vickers Electrical Co., Ltd., hitherto mainly concerned with power units for the generation of electricity. The jet engine produced by this firm presents what may be termed a Continental as distinct from a British appearance as it embodies a nine-stage axial flow compressor, a single annular combustion chamber, a turbine and a jet cone all arranged on a common axis. Thus, in general layout it resembles the BMW 003 unit. With the exception of certain projecting auxiliary components the maximum diameter is 36½in. and the overall length 159in., while the dry weight is 1,700 lb. Earlier engines of a similar design were cleared for flight in December, 1943, with a rated output of 1,800 lb. and were the first axial compressor type turbine units to fly in this country. The first engine of the present series, F2/4, ran its initial test last January, and 3,500 lb. thrust is now developed at 7,700 r.p.m. on a consumption of 1.05 lb./hr./lb. thrust. On the test bench it has already run a 100-hour endurance test under type-test conditions.

The third new jet engine was the Armstrong Siddeley A.S.X. This has a 14-stage axial flow compressor driven by a two-stage turbine and is unusual in the arrangement of the eleven straight-through combustion chambers around the compressor casing parallel to the axis. The flow direction of the compressor is the reverse of the usual arrangement, intake being arranged about midway along the engine and delivery to the combustion chambers at the forward end. The intake air of necessity enters by way of a series of ports passing between the rear ends of the combustion chambers. This arrangement, it would seem, robs the unit of any advantage as regards diameter. The dimensions are 42in. diameter and overall length 167in., with a dry weight of 1,900 lb. First tests were run in April, 1943, and the present rating for take-off and combat is 2,600 lb. thrust at 8,000 r.p.m. at a fuel consumption of 1.03 lb./hr./lb. thrust. For cruising a thrust of 2,050 lb. is developed at 7,500 r.p.m. with a fuel consumption of 1.0 lb./hr./lb. thrust.



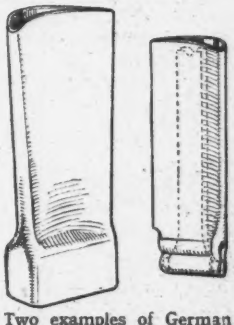
Daimler Benz 601 engine had roller bearing journals and big-ends. Divided races and cages had serrated joint faces.



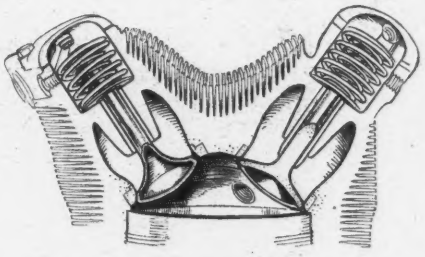
The Walter liquid rocket power unit for the Me.163c interceptor has a supplementary combustion chamber for cruising : On the right are shown sectioned components.

The de Havilland Goblin in quantity production has a thrust of 3,000 lb., but it is interesting to note that further development is being undertaken and Vampire aircraft are now flying with special-category units producing 3,400 lb. thrust.

German jet engines were represented by examples of the Junkers Jumo 004 and the BMW 003, which have already been described in *Flight* (September 13th, 1945). Both were flown at the exhibition by British pilots, the Jumo in the Me 262 and the BMW in the Heinkel 162, the so-called "Volksjaeger." As compared with British jet units the relative elaboration of design was well shown by the display of a number of German jet engine components and control units. Of particular interest were the hollow fabricated turbine blades. Shortage of suitable material would appear to have been the prime reason for this construction, two examples of which are shown in the sketch on this page Both of these blades were internally cooled by air passing radially outwards from the root. The one shown on the right of the illustration has an inserted inner member to direct the air flow along the inner surface of the blade.



Two examples of German hollow turbine blades. That on right has inner member to guide and accelerate air flow over internal surface.



Sectioned cylinder head of BMW801 engine, showing hollow, sodium cooled exhaust valve.

British reciprocating engines are all undergoing further development and Rolls-Royce, Bristol and Napier units were all shown with increased power rating. The Bristol Hercules He 20SM has a take-off rating of 2,000 h.p., but tests at over 2,500 h.p. have already been carried out. The Centaurus CE 22SM has the same nominal rating of 2,560 b.h.p. maximum at 4,250ft. as the Centaurus 57 but is intended for development in the immediate future to 3,500 b.h.p. maximum.

The Napier Sabre VA, fitted with a Hobson fuel injector, has now passed its type test at 2,600 b.h.p.

Later types of Griffons and Merlins will be equipped with a metering fuel injection pump.

German Long-range Rocket Development*

Fuel and Control Systems of V2 : Future Possibilities

By W. G. A. PERRING, F.R.Ae.S.

SERIOUS rocket development was started in Germany in the years 1929-1930 by a few groups of private inventors. This work attracted the attention of the Army Weapons Group in 1933, and in 1937-1938 a special research and development station was set up at Peenemunde at the cost of 300 million marks. Work was started on a range of rockets which they designated A1 to A10, only one of which, A4 or as we know it V2, ever being used operationally. The V2 rocket was the product of Prof. V. von Braun and his collaborators. He compares the present stage of development with that reached by aircraft in the 1914-18 war.

Early work began in 1933, when the A1 rocket was designed. This weighed about 330 lb. and was followed in 1934 by A2, which reached a height of 6,500ft. Developments on A3 started in 1938. It weighed 1,650 lb., was 25ft. long, and about 2.5ft. diameter. Fitted with a power unit developing a thrust of 3,300 lb. for 45 seconds, it reached a height of nearly 40,000ft., while it had a range of about 11 miles when launched at an angle.

Work on A4 commenced about 1940. Firings commenced in July, 1942, and the first success was in October, 1942, when the fourth to be launched flew a distance of 170 miles. Orders for the production of the A4 rocket in quantity were given at the end of 1942, and the first attacks against this country started in September, 1944. Information was, however, in our hands well in advance of this date. During the development which followed, well over a hundred rockets were fired, and although at the end of this period break-ups were less frequent, failures still did occur to some 15-20 per cent. of the rockets fired.

TABLE I.—LEADING PARTICULARS OF THE A4 ROCKET

Lengths	
Overall	46ft.
Warhead	5ft. 11in.
Instrument bay	4ft. 8in.
Fuel compartment	20ft. 3.5in.
Power bay (including Venturi)	14ft. 7.5in.
Diameters	
Maximum diameter of body	5ft. 5.3in.
Diameter over fins	11ft. 8in.
Weights	
Total loaded weight	12.5 tons.
Warhead (with Amatol filling)	2,150 lb.
Structure	3,865 lb.
Power unit	2,235 lb.
Equipment	650 lb.
Main fuels (tanks full)	19,310 lb.
Auxiliary fuels	400 lb.

The leading particulars of the A4 rocket are set out in Table I. The warhead occupies the nose of the rocket and immediately behind the warhead are the main control instruments and radio equipment. The main fuels are carried in two large light alloy tanks occupying the central compartment of the rocket. There are two fuels, one a 75 per cent. solution of ethyl alcohol in water, occupying the forward tank, and the other liquid oxygen.

The rocket is propelled by a jet of hot gases resulting from the combustion of the two fuels in a chamber which forms the front end of the venturi. The fuels are pumped under pressure into this space by two turbine-driven centrifugal pumps, the turbine being driven by a hydrogen peroxide-permanganate system. The performance of the turbine and pumps under operating conditions are set out in Table II.

Pressurised Tanks

Both main tanks are pressurised to about 1.4 atmospheres, to assist the pumps and to prevent the tanks collapsing. The liquid oxygen is fed to eighteen brass roses at the base of cups formed on the end face of the combustion chamber. The alcohol is pumped to a cooling jacket which surrounds the propulsive nozzle of the convergent-divergent type. Finally it is led to the burner cups, where it discharges through a ring of small nozzles and mixes with the liquid oxygen. A small amount of alcohol is fed into the venturi through rings of small holes drilled at several positions along its length, thus providing some degree of internal wall cooling. Examination has shown that the skin temperatures on the inner surface have not exceeded 1,000° C.

The fuel used in the A4 rocket has a specific impulse of about 220 under ground operating conditions; consequently the velocity of discharge of the gases is about 7,000 ft./sec., and since 275 lb. of fuel are burnt every second, the thrust developed by the rocket will be about 60,000 lb. The rocket is placed empty in the vertical position and then filled with fuels in the following order:—

(1) Alcohol. (2) Hydrogen peroxide. (3) Liquid oxygen. (4) Permanganate.

The filling operation takes 12 minutes and was one of the last operations, as 4.5 lb. of oxygen per minute were lost by evaporation if left standing. When the firing torch is alight, the main fuel valves are opened and 20 to 30 lb. of alcohol and oxygen per second are fed by gravity to the combustion chamber and ignited. Combustion is maintained for a few seconds until an observer is assured conditions are satisfactory. He then starts up the flow of auxiliary fuel,

* *Lecture delivered before the Royal Aeronautical Society, November 1st, 1945. (Abstract)*

TABLE II.—PERFORMANCE DETAILS OF A4 ROCKET PROPULSION SYSTEM

Turbine	
Mean diameter of blades and nozzles	18.5in.
Main flow through turbine	3.5 lb./sec.
Working pressure	330 lb./in.²
Turbine back pressure	1.6 lb./in.²
Estimated power at 5,000 r.p.m	680 h.p.
Endurance at 3.5 lb./sec.	113 secs.
Oxygen Pump	
Overall impeller diameter	10.55in.
Flow at 5,000 r.p.m.	160 lb./sec.
H.P. at 5,000 r.p.m.	320
Delivery pressure	350 lb./in.²
Alcohol Pump	
Overall impeller diameter	13.45in.
Flow at 5,000 r.p.m.	125 lb./sec.
H.P. at 5,000 r.p.m.	360
Delivery pressure	370 lb./in.²
Assuming 5 per cent. of alcohol used inefficiently as coolant, and 5 per cent. returned by spill valve to lower pressure side of pump :—	
Total fuel delivered to combustion chamber	275 lb./sec.
Specific thrust	220 lb./sec.
Total thrust	60,000 lb.
Capacity of main tanks	19,300 lb.
Endurance at full flow (approx.)	70 secs.

the turbine is started and reaches full speed in about 3 seconds. The flow of the main fuels increases, thrust builds up and soon exceeds the weight, causing the rocket to commence its vertical ascent, the whole operation, from firing the torch to full thrust, taking only from 7 to 10 seconds.

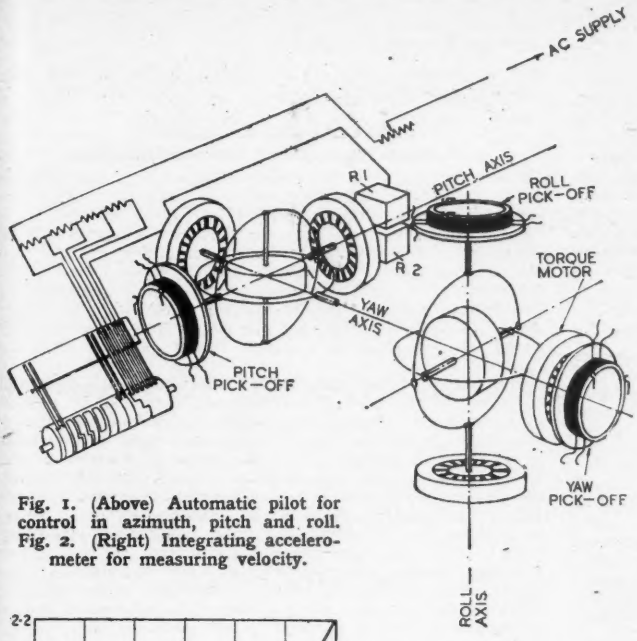
Control

For maximum range it is necessary to turn the rocket on to its course and rotate it from the vertical until it takes up an angle of about 40° to 45° to the horizontal by the time it has reached the "all burnt" stage, i.e., after 60 seconds' flight. To control the motion of the rocket in azimuth, roll and pitch, an automatic pilot was fitted. One form, Fig. 1, comprised two electrically driven gyros, one with its axis along the axis of the rocket, and the other with its axis perpendicular to the axis of the rocket and to the plane containing the target. This second gyro detects the roll and yaw of the rocket, but is unaffected by the pitching motion; the roll and yaw is measured by means of two fine-wire potentiometers, and their outputs, after passing through an electronic amplifier, operate the control vanes.

The other gyro provides a pitch control, and during flight is made to precess towards the horizontal in the roll and yaw plane. The movement is detected by means of a fine-wire potentiometer; the output from the potentiometer is fed into an amplifier and operates the control vanes through their appropriate servos. The pitch control unit consists of five independently adjustable resistances in series with the pitch discriminator coil. Four of these resistances are initially shorted, and as they are brought in successively, give five different rates of precession.

Early rockets contained two radio sets,

GERMAN LONG-RANGE ROCKET DEVELOPMENT



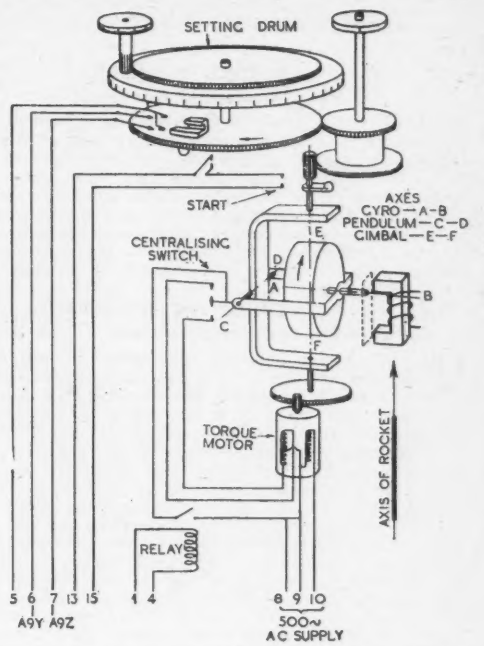


Fig. 1. (Above) Automatic pilot for control in azimuth, pitch and roll. Fig. 2. (Right) Integrating accelerometer for measuring velocity.

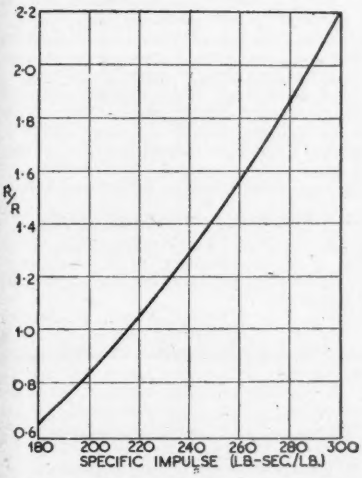


Fig. 3. Influence of specific impulse on range. $\alpha = 0.67$. Weight = 11.24 tons Diameter = 66 inches. $\frac{\text{Thrust}}{\text{Initial weight}} = 2g$.

one a receiver transmitter, and the other a receiver for velocity measurement and range control. The velocity was measured by a Doppler effect. Elaborate security arrangements were built into the circuits to prevent influence by false signals.

The radio method was soon dropped in favour of an integrating accelerometer, Fig. 2, which made the rocket independent of ground control. It consists of a pendulous gyro mounted in gymbals and operating two sets of contacts whose angular separation can be varied. The gyro case carries a centralising switch, the leads of which run to a reversible induction motor geared to the gymbal. Any deviation from the mid-position of the gyro axis causes a torque to be applied to the gymbal to precess it back again. Because the centre of gravity of the gyro does not lie on the axis *CD*, any acceleration of the system parallel to the axis *EF*, i.e., the rocket axis, will cause precession about this axis at a rate proportional to the acceleration. The angle of precession will be proportional to the integral with respect to time of all accelerations, including any component of the earth's gravitational field acting in the direction *EF*.

The actual operational range varied widely, a few rockets travelled as far as 220 miles, but most averaged 180-190 miles. Since the main path is parabolic, the height reached will always be about a quarter of the range. The total time of flight is about five minutes. The highest acceleration reached, which is at "all burnt," when thrust had risen to 69,000 lb. and the weight has fallen to 8,900 lb., is just under 8g. The highest velocity reached is at "all burnt," the rocket is then travelling at 5,000 ft./sec. and it is interesting to note that at this velocity the rocket motor is developing well over 600,000 horse-power.

Effect of α on Range

In discussing rocket performance it is useful to introduce the ratio of fuel weight to total weight, referred to as the "α" of the rocket. The α in the case of the A4 rocket is about 0.69. Variations of α have much more influence, on range, than variations of size; a 50 per cent. increase in weight for the same α increasing the range 10 per cent., whereas only a 2 per cent. change in α produces the same effect. If the 2,150 lb. warhead were replaced by fuel, α would have increased to 0.76, and the range to about 350 miles.

Fig. 3 shows the influence of the specific impulse on range; it will be observed that an increase from 215 to 298 would double the range of the rocket. Improved S_1 of a given fuel can only be had at the expense of greatly increased working temperatures and pressures of the gases in the combustion chamber. The other course to improve range is the choice of different fuels. Table III gives the specific impulse of a number of fuels calculated on the basis of working conditions corresponding to the venturi characteristics of the A4 rocket. Most practical values of the S_1 lies between 180-240, but by using hydrogen and oxygen the value could be pushed up to well over 300.

The Future

The rocket motor, with its light weight, and its very large thrust per square foot of frontal area, has made flight at speeds well into the supersonic range possible and a few calculations have been made to illustrate some possibilities. Starting with the A4 rocket, we have assumed that the warhead is replaced by a pressure cabin and pilot. In addition, the rocket is fitted with wings; the area being arranged to provide for a landing wing loading of 35 lb./sq. ft.

Three cases will be touched briefly. In the first, the A4 rocket with wings is fired vertically and controlled in the same manner as a normal A4 rocket until the top of its trajectory, when the pilot takes over and glides the rocket to the

(*Continued on p. 511*)

TABLE III.—SPECIFIC IMPULSE OF VARIOUS FUELS

	Volume Ratio	K° Combustion Temperature	γ	Molecular Weight	Specific Impulse
Ethyl Alcohol and Oxygen	1 : 1.15	2,780	1.2	20.0	235
Petrol and Oxygen ...	1 : 1.4	2,240	1.3	16.5	224
Hydrogen and Oxygen ...	1 : 3.2	2,560	1.2	8.4	343
Hydrazine Hydrate and Hydrogen Peroxide ...	1 : 2.03	1,750	1.2	24.0	200

CORRESPONDENCE

The Editor does not hold himself responsible for the views expressed by correspondents. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

BEFORE THE ARK

The Hermes and Her Designer

IN *Flight*, September 20th, your correspondent, Michael Dawson, is quite correct in stating that H.M.S. *Hermes* was the first aircraft carrier built and designed as such for the Royal Navy. All previous carriers were "conversions," having started their life as something other than an aircraft carrier.

However, the suggestion that *Hermes* was designed by Sir Dennis Burney is not correct. She was designed by Sir E. H. Tennyson D'Eyncourt, the Director of Naval Construction at the time.

J. L. BARTLETT.

TURBINE JET ENGINES

Oil Consumption Compared with Piston Engines

OIL consumption has been of so much interest to aircraft designers and operators in the case of piston engines that no doubt this interest will also be displayed in regard to jet engines, and, therefore, it may not be out of place to point out that the attractively low oil consumption figures of 1-2 pints per hour generally quoted for jet engines are only a fraction of the total oil consumption for the unit.

In your extremely informative account of the Derwent V engine (*Flight*, October 25th) it is stated that 1 per cent., by volume, of engine oil has to be added to the fuel to ensure lubrication of the injector equipment, and taking your editorial estimate of 1 lb. fuel per 1 lb. thrust, we get for the 4,000 lb. thrust an oil consumption of the order of 40 pints per hour, or, shall we say, 30 pints at maximum cruising conditions.

C. L. FRASER.

AIRCRAFT APPRENTICES

An M.P.'s Question in the House

ON October 9th I asked the following question of the Minister of Labour:—

"Whether he will regard apprentices indentured to aircraft firms before the age of 16, for the purpose of studying for the Air Registration Board's examination to qualify as licensed ground engineers, as exempt from call-up in view of the fact that such a licence is the only one recognised by the Air Ministry as qualifying the holder to certify the safety of aircraft and engines for flight."

The Minister of Labour replied:—

"If the Hon. Member would let me have particulars of any individual cases that he has in mind, I would consider whether they satisfy the conditions under which apprentices are deferred as such, and, if not, whether there are other grounds that would justify deferring their call-up."

I should be glad to hear from any firm with such apprentices so that I may submit their names to the Minister of Labour.

ERIC L. GANDAR DOWER.

ECONOMICS OR EXTRAVAGANCE?

Fate of Surplus Sunderlands

IN *Flight* (October 25th) "Indicator" says he knows that Sunderland flying-boats surplus to R.A.F. requirements have been and are being scuttled in the Irish Sea because no use can be found for them.

I emphatically disagree that they are useless; as the Sunderland was developed from a transport machine, the Empire series, I fail to see why it cannot be reconverted and used as a transport for such things as perishable goods and urgently needed material. The argument that it would be too expensive either to reconvert or operate them is nonsensical; if the Government can afford fifteen millions a day on war, then it can afford to operate a subsidised airline with these aircraft. There are many uses for a ubiquitous aircraft such as the Sunderland; for instance, the evacuation of prisoners of war from the Far East or the transportation of urgently needed British exports to the Continent. Or why not sell them cheap to foreign countries, who would snap up the chance of obtaining such formidable machines cheap for the defence of their country? This, too, would greatly enhance the prestige of the British aircraft industry and Britain as a whole, a fillip which we need in certain parts of the globe.

In any case, it is surely more profitable to dispose of an aircraft cheaply than just to sink it, lock, stock and barrel. It is a wonder to me that taxpayers stand for what is really their property being wasted in this fashion when it could be usefully employed. Or perhaps the great British public are too complacent to care.

JOHN C. BRAY.

REFUELLING IN FLIGHT

Trebled Payload and Unlimited Range

IN *Flight*, October 18th, two correspondents made reference to the Lord-Nicolson patent of 20 years ago. This was based on an idea conceived by my old friend John Lord and Capt. Nicolson, but no steps were taken to develop the scheme beyond that necessary for the preparation of a patent specification. Some years later, when I decided to carry out a full investigation of flight refuelling with a view to making it a practical proposition, it was deemed worth while acquiring the Lord-Nicolson patent, and the claims were experimentally tested, but were turned down in favour of more promising methods.

Mr. Huntley is bold enough to state that "if a sound principle for assisted take-off is introduced, there can be no case for refuelling in the air, unless it be for *endurance* records" (my italics). His one word "endurance" sums up the claims of refuelling in flight, since by this means we are able to give *unlimited range* to any short-range aircraft. In other words, our primary job is to transfer fuel in flight at one or more carefully pre-arranged points along the airliner's route, with a view to relieving the liner of the obligation to carry the vast quantities of fuel required for long non-stop flights. In this manner it so happens that the revenue payload can be trebled, or even quadrupled, and it can be shown that the cost of the refuelling service is but a small fraction of the additional revenue gained.

The full benefits of assisted take-off and climb are immediately available to any flight-refuelled service, and, important though this factor is, it is regarded by us as merely a by-product of flight refuelling, but we do strongly recommend that a combination of both assisted take-off and extension of range should form the ideal basis of any flight-refuelled service. This aspect is elucidated in Mr. Latimer Needham's next article on the subject, which it is hoped will be published in an early issue of *Flight*.

ALAN J. COBHAM,
Managing director, Flight Refuelling, Ltd.

Equal or Greater Advantage to Flying Boats

I HAD not wished to take part in the correspondence on the subject of refuelling in flight. In view of Mr. Hornsby's letter in your issue of October 18th, however, my continued silence might be misunderstood.

I must say emphatically that I see no reason to alter or retract anything that I have said or written on the subject in the past. In July, 1940, Sir Alan Cobham and I gave a joint lecture to the Royal Aeronautical Society (*Journ. R. Ae. S.*, July, 1940), in which we showed how wing loading and range could be increased with economic advantage; how aircraft could have their tanks topped up *en route*; how take-off run could be reduced with a great saving in airport cost; and how initial angle of climb could be greatly increased with a corresponding improvement in safety.

The scientific and technical reasons which were given in support of these conclusions remain qualitatively sound, but with the passing of time and the incidence of other advances the scale of the advantages has altered. Nevertheless, aerodynamic improvements which have reduced the drag of aircraft leave refuelling in flight where it was as an added advantage. Little has been done to reduce the specific fuel consumption of engines, fuel loads have increased, take-off runs become much longer, and initial angles of climb have deteriorated. And there has been a deplorable crop of transport accidents as a result.

It is unfortunate that the war stopped the promising trans-atlantic experiment in refuelling, which was very successfully begun in 1939, and that war "economy" has so altered our sense of values for the worse.

Mr. Hornsby raises the question of flying boats, and asks how their design could be influenced by refuelling. The advantages would be the same as with "land" planes, except in one detail, where they would be greater. The weight of a boat hull is usually about 12 per cent. of the water-borne load, and in as far as that load can be cut down (even though subsequently increased in flight), hull weight can be saved, with a corresponding increase in pay-load. Thus, in a boat like the Shetland, 4,000 lb. could probably be added to the pay-load if 5,000 gallons of the fuel were put on after the take-off, the hull being re-designed to take advantage of this.

CORRESPONDENCE

But, in my opinion, the full advantages of refuelling will not be realised until a new aircraft is specifically designed from the start to take advantage of it.

Finally, Mr. Hornsby refers to my personal history, and I must remove the possibility of a misunderstanding which might arise from his statement. It is true that at one time I was a member of the design staff of Messrs. Saunders-Roe, Ltd., whilst Capt. Nicolson and the late Mr. John Lord were directors, but if they were at that time investigating the possibilities of refuelling in flight, I had no knowledge of it. My technical interest in the subject was first aroused by Larrard's pioneer study published in the *Journal* of the Royal Aeronautical Society in 1931 (Vol. XXXV, p. 1137). I did not join Sir Alan Cobham until 1938, and resigned my position as chief engineer last year. I have now no connection with Flight Refuelling, Ltd., and am engaged on entirely different work.

MARCUS LANGLEY.

CABIN HEATING

Independent System Not Justified

I AM surprised to note, from reports in *Flight*, that in certain aircraft an independent oil-burning system is used for cabin heating.

The total heat lost in the cooling and exhaust systems of a multi-engined aircraft is enormous—equivalent to thousands of kilowatts if expressed in electrical terms and sufficient to heat and light a village if all were recoverable. What justification is there for carrying supplies of fuel in commercial aircraft for supplying heaters when a small fraction of the lost heat would suffice?

Light and efficient heaters have been used, in which air is blown through heat exchangers on the exhaust system, and, apart from the fact that in one's experience the only alternatives in the aircraft are blisteringly hot or icy cold blasts of air, occasionally mixed with exhaust gas, the principle appears to have been proved.

G. W. G.

[Our correspondent would appear to have answered his own question.—ED.]

OBSERVERS' ASSOCIATION TO AFFILIATE TO AIR LEAGUE

MEETING at White Waltham airfield on October 28th, the Observers' Association, which was formed during the war of members of the Royal Observer Corps, decided to affiliate to the Air League of the British Empire.

Mr. E. Colston Shepherd, Secretary-General of the Air League, explained that the League could provide the Observers' Association with, among other things, the services of office staff and enable it to continue on a peacetime basis. Lecturers would be sent on request to branches of the Association and films made available.

Mr. Colston Shepherd said that the League intended, with the co-operation of British aircraft manufacturers, to make short films showing the flight characteristics of new British aircraft as soon as they had passed their flying tests.

He added that, whether Empire Air Day was revived or not, the Air League would organise air displays in various parts of Britain, and the O.A. could give valuable assistance in connection with these efforts.

It was also suggested to the meeting that the Observers' Association could assist in the promotion of the cause of British aviation on a local basis by taking a particular interest in matters such as the siting of airdromes in town planning.

In his introductory remarks Mr. Colston Shepherd said that in his recent conversations with British aircraft manufacturers he had formed a rather gloomy picture of the immediate prospects of British civil aviation so far as the quantity production of new types was concerned. There was a great need for propaganda on behalf of British aviation to be mobilised.

After some discussion at the annual general meeting of the Observers' Association which was held in the afternoon, delegates passed a resolution agreeing in principle to affiliation with the Air League. It was emphasised that the separate identity of the Association would be preserved.

Welcoming the Association to White Waltham, Commodore d'Erlanger briefly described the work of A.T.A. during the war and said that, thanks to the Royal Observer Corps, at the time when our "Ack-Ack" defences were rather "quick on the trigger," not one aircraft which was being piloted by the A.T.A. was fired at. The R.O.C. had throughout the war also been of great assistance in locating "lost" A.T.A. aircraft.

Sir Frederick Handley Page spoke of the value of technical training for boys who were entering the aircraft industry and described the scheme of apprenticeship which his own firm has instituted. It is hoped that with the aid of the funds which members of the Observers' Association subscribed during the war scholarships in aeronautical engineering will be granted to children of members who show sufficient keenness and promise.

A programme of flying had been arranged for the White Waltham occasion, but it was restricted by ten-tenths low cloud to a display by a Fairey Firefly I, a Fairey Barracuda, a Miles Aerovan and a Miles M.28 at low altitudes.

German Long-range Rocket Development

(Concluded from page 509)

ground along its optimum glide path.

In the other cases, the A4 rocket with wings has been taken up by means of a booster rocket, on the lines of the German A10 project. In this way the rocket reaches a height of 80,000 feet before being released at a speed of 3,000 m.p.h. From this point the rocket with full fuel continues the flight, and in the first boosted case it has been assumed that the venturi is re-designed, and provides a thrust corresponding to level flight at 1,640 m.p.h., at 80,000 feet. In the other, the re-designed venturi provides a thrust which enables the rocket to continue the climb. The results of these calculations are set out in Fig. 4.

The effect that the addition of wings has on range is striking. The range of 180 miles of the normal rocket has now been raised to 350 miles. More striking is the effect of the booster on general performance. Ranges of 1,500 to 3,000 miles now appear to be possible and the advantage of continuing the climb at the end of the booster stage is very marked. With a rocket boosted in this way it would be possible to travel from London to New York in well under the hour.

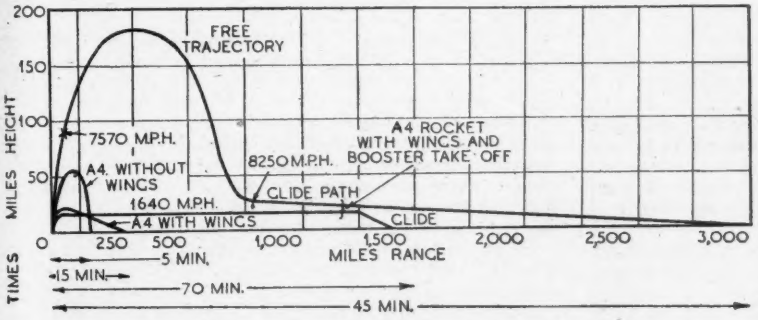


Fig. 4. Trajectories of single- and two-stage winged rockets.

The first two cases of the rocket with wings present no problem that is outside the experience already gained by the Germans on the A4 rocket; the third case, however, does raise many new problems. It contemplates flight at over 8,000 m.p.h., and this means a stagnation temperature of nearly 7,000 deg. K. Over a large part of the flight the rocket would be moving on a free trajectory, since the wings cannot provide sufficient lifting force to control the motion. Over this part of the trajectory the pilot would be subject to zero g, and it would not be until the rocket returned to about 28 miles above the earth's surface that the pilot could begin to assume control.

The booster contemplated in connection with these schemes would be very large. It would certainly weigh about 100 tons, and the Germans, in planning their schemes, had hoped that the booster, after being jettisoned, would be recoverable.

CIVIL AVIATION

Air Transport to be State-controlled

Government Policy Outlined : Three or More Public Corporations to Operate All Services : Charter and Private Flying to be "Free"

AFTER careful consideration the Government has decided that public ownership shall be the overruling principle in air transport and that there should be no further financial participation in it by surface transport interests. At least two new corporations, in addition to B.O.A.C., will be established for the operation of internal and European services, in one case, and of services to South America in the other. B.O.A.C. will continue to operate the Commonwealth, North Atlantic and Far Eastern services, and will handle the others until such a time as the new corporations have been formed. Charter flying will be open to private operators, and there will be no restrictions on private flying or gliding after January 1st, 1946.

These, briefly, were the points made by Lord Winster, the Minister of Civil Aviation, when he made his promised statement on Government civil aviation policy in the House of Lords on November 1st.

He wished to make it clear that the decision to nationalise air transport had been reached in no spirit of opposition to other interests. The policy would be developed with the intention of closest co-operation with land and sea transport systems and consultations with the interests concerned would start forthwith. These consultations would need to be concluded before the promised White Paper could be issued.

Since the arguments against a single monopoly corporation were overwhelming, the Government had decided to ensure through rivalry rather than competition that several possible approaches to the various problems in air transport should be tried. He intended, therefore, to establish, in addition to B.O.A.C., two new corporations, as outlined above, and it might even be that further corporations or subsidiaries would be established if these were found to be desirable. All such corporations and subsidiaries would be financed wholly out of public funds, the boards being appointed by the Government to conform with their general policy. Normally, however, he would not interfere with the day-to-day work of administration.

B.O.A.C. to Carry On

These proposals would require necessary legislation, and until this had been put through B.O.A.C., under the directions issued on October 6th last year, would continue to be responsible for all external services, and would be asked to start, as soon as possible, European and South American services and to operate these until the corporations had been formed. Since a complicated legal procedure was involved as far as internal services were concerned, these would for the time being be run by the existing operators.

Private firms would still be permitted to operate charter and taxi services, but the corporations would also be empowered to do so. Apart from those concerned with safety regulations, there would be no restriction on private and club flying, or on gliding, and the ban concerned would be removed as from January 1st, 1946. A joint announcement would shortly be made giving details of this.

The cost of necessary airport provision had risen enormously in recent years, and airports must therefore be provided on a planned basis. For this reason all transport airports would be acquired by the Ministry of Civil Aviation and would be publicly owned, though other airfields would remain free. The Ministry would be responsible for all radio, meteorological and flying control services.

In the matter of compensation, Lord Winster said that fair payment would certainly be made for any physical assets taken over, and, pending the necessary legislation, any operator would, for the time being, be legally free to run services without permits and at his own risk.

Depending on traffic demands, plans had been made for certain international services to be operated from and to Prestwick, thus ensuring that Scotland would be able to play a full part in civil aviation.

Arrangements were being made for the Ministry of Civil Aviation to have the same facilities at the Ministry of Supply as those given to the R.A.F. and Fleet Air Arm. The Brabazon Committee would remain in existence.

Orderly Development

Lord Winster reaffirmed that the Government stood for orderly development in world civil aviation, and any international arrangements made would be as co-operative as possible where other interests were concerned. The Government had, in fact, the work of developing an important new form of transport, and he did not wish to see the evil results of speculation and greed, such as were seen in the early development of railways and shipping. He wanted the pilots to feel that they were engaged in a service to the community which might eventually become a service to the world.

For the Opposition, Lord Swinton deplored the "throwing of the issue into the political cockpit" and defied the Minister to point to anything in the previous Government's scheme which would have led to "scrambling competition." No argument, other than the need for State ownership, has been given to explain why the previous plan should have been changed, and he saw no reason why the railways, shipping companies, and travel agencies should be discouraged from contributing to civil aviation their knowledge of the transport business. How could the supposed co-ordination come about if these interests were to have no say in the matter?

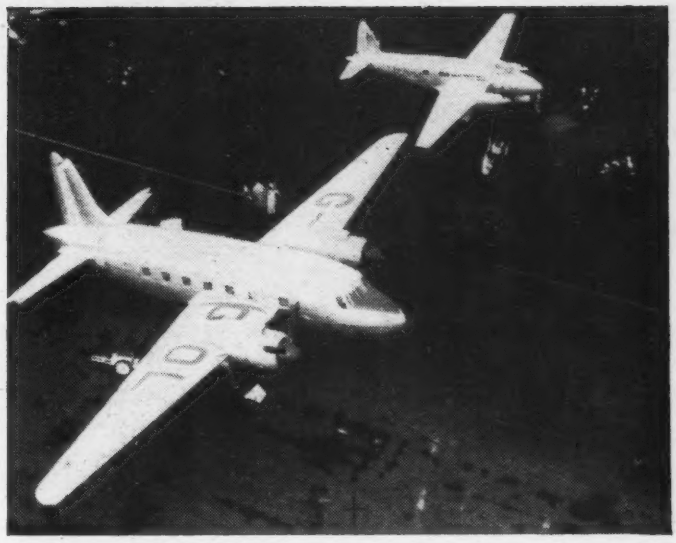
Would control of the corporations lie with the Minister of Civil Aviation or with the directors? If the former, then the boards would automatically become civil servants. The essence of the old plan was that of independent management. What chance was there for the encouragement of new blood in a sealed-pattern scheme? There had already been sufficient delay, yet the new scheme involved further indefinite delay and Lord Swinton thought that this was a sorry day for the future of civil aviation.

Lord Rennell complained that the new policy formed a break in the continuity of that for civil aviation. The State-owned corporations would need to negotiate with private companies in the United States. He did not see how there could be healthy rivalry between what were virtually "three parts of the Government." Was it intended that the State-owned airlines should compete with, and at the expense of, surface transport companies?

In the House of Commons on the same day Mr. Ivor Thomas, Parliamentary Secretary to the Ministry of Civil Aviation, also gave an outline of the Government's policy.

The debate in the House of Lords was continued last Tuesday.

CIVIL AVIATION NEWS



AT FARNBOROUGH: Civil aircraft development was relatively well represented at the R.A.E. Display. Here are the Vickers Viking and the new D.H. Dove—which was actually the prototype.

ANSONS FOR BRAZIL

TEN aviation companies are at present being organised in Brazil, and nine are already in operation. One of them, Brazilian Trans-Continental Aviation, has bought five Avro Ansons from Canada and is expecting to acquire more of various types.

FREIGHTERS AND WAYFARERS

VERY soon now it is expected that the prototype of the Bristol 170 will be flying, while three further prototypes are well on their way to completion. It will be remembered that the 170 has been planned in both cargo and passenger versions under the type names Freighter and Wayfarer.

JOINTLY TO SOUTH AFRICA

THE South African through run from this country will be reopened this week-end, November 10th, the services being operated jointly by B.O.A.C. and South African Airways. On that date an S.A.A. York will leave Johannesburg and a B.O.A.C. York will leave Hurn. For the time being the service will be operated once a week in each direction on a day-flying basis only.

PRESTWICK—U.S.

IN preparation for the future, Scottish Aviation have made an application to the U.S. Civil Aeronautics Board for a passenger and freight carrier permit between Prestwick, New York and Chicago, with supplementary services on the short-stage route via Iceland and Greenland. Since all British aviation companies are under the jurisdiction of the Ministry of Civil Aviation, a similar application had previously been lodged with this department. The new civil aviation set-up presumably nullifies any plans.

SUNDERLANDS FOR SOUTH AMERICA

IT has been known for some time that a South American shipping line, Compania Argentina de Navegacion Dodero, S.A., had placed an order for civil versions of the Short Sunderland flying-boat, and the first of these was due to be launched at Belfast last week. Air Cmdre. Powell will be in charge of the flight delivery arrangements from Poole to the Argentine, via Lisbon, Bathurst and Natal, and the boats will be flown out by B.O.A.C. crews.

Four of these civil Sunderlands have been ordered, and they are being equipped to carry 40 passengers and 1,000 lb. of freight. At an all-up weight of 59,000 lb. the Sunderland's range will be 2,000 miles at 175 m.p.h.

CIVIL REPUBLIC

WITH all the American manufacturers who are now concentrating on the production of civil aircraft, Republic Aviation have laid down a design for a fast 40-seater landplane. Orders have apparently been placed by Pan American Airways for six of these aircraft, which has the decorative type name of Rainbow. The calculated cruising speed will be 400 m.p.h. with four 3,250 h.p. Wasp Majors. The fuselage will be pressurised.

The estimate take-off weight will be 113,250 lb., with a payload, over a 4,150 miles range, of 10,000 lb. The stalling speed is given at 95 m.p.h.—part of the price paid for such a very high cruising speed.

K.L.M. AND THE ATLANTIC

THE Atlantic seems to be unnaturally attractive to operators. In co-operation with American Export Airlines, K.L.M. are now planning to operate an Atlantic service in the early summer of 1946, using Douglas DC-4s or Lockheed Constellations if the latter are available. Before next spring they hope also to reopen their Far East service on a daily basis and, in due course, a twice weekly service to Brazil.

THE LATÉCOÈRE ACCIDENT

AFTER two false starts followed by a very impressive crossing of the South Atlantic on its survey flight, the Latécoère 631 suffered serious trouble in Uruguay last week. The boat was force-landed on Lake Joso Ignacio after some drastic form of failure in which two passengers lost their lives. The boat was beached after the landing and it may not be possible to salvage it.

P.A.A. MAKE A START

LAST week Pan American Airways, after nearly six and a half years of trans-Atlantic flying-boat operation, made their first scheduled landplane crossing with a DC-4 Skymaster. Though this was the first "civil" landplane service, P.A.A. crews have been making regular runs for the U.S. Army Air Transport Command with the military version of the DC-4.

The Skymaster on this first trip carried eleven passengers and 1,330 lb. of freight and mail, with a crew of seven. Future services will be on a twice-weekly basis from La Guardia, via Gandar, Newfoundland and Rineanna, to Hurn. Although the use of boats over the North Atlantic has been discontinued, these will still be flown to Lisbon until such a time as P.A.A. have their full fleet of eight converted DC-4s in service. The company are still waiting for an approval from the Civil Aeronautics Board for their recently announced fares.

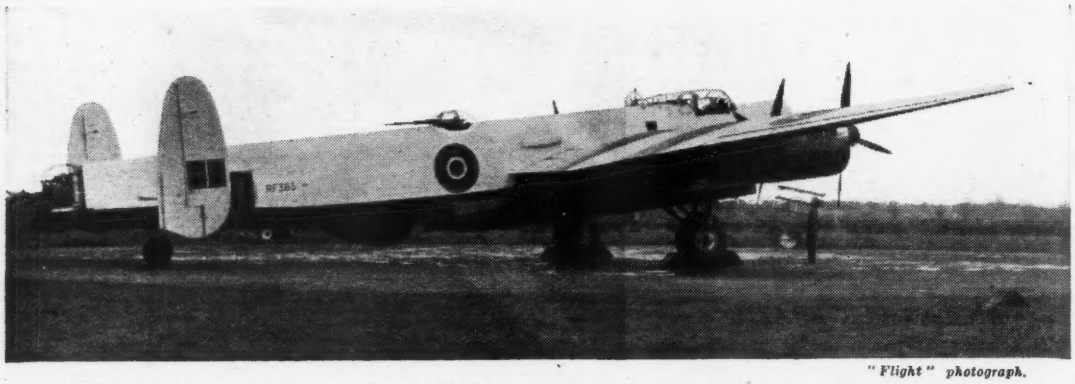
DUBLIN—PARIS?

ACCORDING to reports from Dublin, reciprocal air agreements with Continental countries are to be made by the Eire Government for the operation of services by Irish Air Lines to European capitals.

It is believed that the first of these agreements will be made with the French Government and will provide for a service from Dublin to Paris, via Rineanna—presumably to pick up Atlantic travellers. Other countries listed for agreements on a similar basis are Belgium, Holland, Sweden, Norway, Italy and Portugal, facilities for reciprocal services being provided for in each case.

Three Douglas Dakotas have been purchased in the U.S. for Irish Air Lines and negotiations have been opened for the acquisition of further aircraft by the company. Mr. J. F. Dempsey made this announcement on his return from the I.A.T.A. conference, and added that a service to London would be started as soon as possible.

SERVICE AVIATION



"Flight" photograph.

SHIPSHAPE: This view of the Avro Lincoln II shows clearly the neat Bristol B-17 dorsal turret, mounting two 20 mm. cannon.

Royal Air Force and Naval Air Arm News and Announcements

Appointment

AIR Vice-Marshal (Act. Air Marshal) W. A. CORYTON, K.B.E., C.B., M.V.O., D.F.C., is to be an additional member of the Air Council on appointment to the Ministry of Aircraft Production. October 15th, 1945.

Promotion

Technical Branch.

Air Comdre. O. E. CARTER, C.B.E., A.F.C., is granted the acting rank of Air Vice-Marshal.

Awards

THE KING has been graciously pleased to approve the following awards in recognition of gallantry and devotion to duty in the execution of air operations:—

Bar to Distinguished Service Order

Act. Wing Cdr. L. MACD. HODGES, D.S.O., D.F.C., R.A.F., No. 357 Sqn.—Wing Cdr. Hodges has completed two tours of operational duty. He has taken part in special duty operations over Burma, Siam and French Indo China and has also flown on several long range sorties to Malaya, some of which entailed fights of over 20 hours' duration. At all times this officer has set a fine example of determination and endurance. An outstanding leader, Wing Cdr. Hodges has moulded his squadron into a high standard of operational efficiency.

Distinguished Service Order

Act. Group Capt. J. GRANDY, R.A.F.—Group Capt. Grandy has completed numerous operational missions. During the Battle of Britain his aircraft was shot down while he was leading his fighter squadron. As Wing Commander he has flown on many hazardous sorties over the Burmese theatre of war. This officer has always been the first to undertake difficult flights or to land on any new landing ground. His personal leadership on air supply operations has been a very large factor in the successful record achieved by the squadrons of his wing.

Act. Group Capt. K. J. MELLOR, D.F.C., R.A.F., No. 233 Sqn.—Group Capt. Mellor has commanded an operational squadron since 1940. He has an exceptional record of skill and ability both in Bomber and Transport Commands, having completed four tours of duty. He led his squadron during all the North European airborne operations, showing courage and determination of a high order on all occasions. His courage and devotion to duty have set a fine example to his squadron.

Act. Wing Cdr. J. E. S. HILL, R.A.F.O., No. 177 Sqn.—This officer is in command of his squadron and his leadership and ability as a fighter pilot have been reflected in the fine operational record of the squadron. He organised and led the first wing long range patrol of the Moulmein-Bangkok railway. On one occasion, while flying at low level, he was attacked by four enemy aircraft. Despite the low level he did not break off the engagement until the starboard wing of his aircraft was on fire and he had accounted for at least one of the enemy fighters. Throughout, Wing Cdr. Hill's fine fighting spirit and inspiring leadership have set a magnificent example to all.

Act. Sqn. Ldr. A. J. MCGREGOR, R.A.F.V.R., No. 123 Sqn.—This officer has a long record of operational flying. He took part in the Battle of Britain and has served in the Western Desert and in the Far East. Since November, 1943, Sqn. Ldr. McGregor has been engaged in operations in support of the 14th Army on the Arakan front and has led his squadron on numerous escort, patrol, supply dropping and close support sorties. Under his leadership all these sorties have been completed with efficiency and success. Both in the air and on the ground this officer has set an inspiring example by his skill, determination and devotion to duty.

Flt. Lt. R. A. BROWNE, R.A.F.V.R., No. 267 Sqn.—This officer has flown on a large number of operational sorties over enemy occupied territory, landing supplies and ammunition to the Yugoslav partisans. After unloading his supplies he has flown out casualties from very small landing fields. He has led formations of transport aircraft over enemy occupied territory and owing to his skilful leadership no aircraft have been lost. More recently Flt. Lt. Browne has been operating over the difficult terrain of Burma, where he has never let the worst monsoon weather deter him from completing his objective. At all times by his courage, fine leadership and devotion to duty this officer has set an inspiring example.

Act. Sqn. Ldr. D. A. MACFADYEN, D.F.C., R.C.A.F., No. 406 (R.C.A.F.) Sqn.—Since the award of a bar to the D.F.C. this officer has continued to operate against the enemy with conspicuous success, destroying three enemy aircraft and damaging five. During a patrol over Czechoslovakia in March, 1945, an enemy landing ground was sighted and one enemy aircraft was destroyed on the ground and four were damaged. On another occasion, in April, 1945, he successfully destroyed two hostile aircraft in the air. Sqn. Ldr. MacFadyen's total victories are at least 13 enemy aircraft destroyed and 17 damaged. Throughout his two tours he has displayed outstanding keenness, efficiency, courage and determination and has at all times set a fine example of loyal and devoted service.

Act. Wing Cdr. W. J. MACLEAN, D.F.C., A.F.C., R.A.A.F., No. 117 Sqn.—This officer commenced his flying career in September, 1941, and completed many sorties, both by day and by night, in support of the 8th Army in the Western Desert. He has a very fine record of service as an operational pilot. In June, 1944, Wing Cdr. MacLean was appointed to command a squadron. Since then his unit has achieved much success which has been in a great measure due to his untiring efforts and organising ability. Wing Cdr. MacLean has taken part in operations in both the Middle East and Burma theatres of war. His energy and courage have been an example to all.

Second Bar to Distinguished Flying Cross

Flt. Lt. J. T. CAINE, D.F.C., R.C.A.F., No. 406 (R.C.A.F.) Sqn.—Flt. Lt. Caine has completed many operational sorties since the award of a Bar to the D.F.C. In May, 1944, whilst on a patrol in the Barth area he inflicted much damage on the enemy's lines of communication and destroyed several enemy seaplanes at anchor. In April, 1945, while over South East Germany he destroyed one enemy aircraft and damaged a further two. Despite the fact that on this sortie Flt. Lt. Caine's aircraft was hit by anti-aircraft fire which damaged the flying controls, a successful return to base was made. His indomitable fearlessness and skill have merited the highest praise. Since his previous award he has destroyed a further eleven enemy aircraft, bringing his total victories to at least 20 enemy aircraft destroyed.

Bar to Distinguished Flying Cross

Act. Sqn. Ldr. H. L. COONS, D.F.C., R.C.A.F., No. 435 (R.C.A.F.) Sqn.

Act. Sqn. Ldr. T. P. O'BRIEN, D.F.C., R.A.F.V.R., No. 357 Sqn.

Act. Sqn. Ldr. M. VLASTO, D.F.C, R.A.F.V.R., No. 52 Sqn.

Distinguished Flying Cross

F/O. R. K. B. RAO, R.I.A.F., No. 2 (R.I.A.F.) Sqn.

Flt. Lt. W. W. PEET, R.N.Z.A.F., No. 74 Sqn.

F/O. R. M. CLARKE, R.N.Z.A.F, No. 485 (N.Z.) Sqn.

P/O. R. M. BULLEN, R.N.Z.A.F., No. 358 Sqn.

W/O. D. T. LAING, R.N.Z.A.F., No. 69 Sqn.

Maj R. J. CLEMENTS, S.A.A.F., No. 16 (S.A.A.F.) Sqn

Capt. G. B. SMITH, S.A.A.F., No. 17 (S.A.A.F.) Sqn.

W/O. R. J. WICKS, R.A.F.V.R., No. 109 Sqn.

W/O. H. WINN, R.A.F.V.R., No. 75 (N.Z.) Sqn.

Distinguished Flying Medal

Flt. Sgt. F. H. KEMPIN, R.A.F.V.R., No. 186 Sqn.

Flt. Sgt. J. K. KERSHAW, R.A.F.V.R., No. 35 Sqn.

Flt. Sgt. P. J. LEEVES, R.A.F.V.R., No. 35 Sqn.

Flt. Sgt. R. S. LIVERSEDGE, R.A.F.V.R., No. 9 Sqn.

(Left) Badge of No. IX Bomber Squadron, R.A.F. — "Per Noctem Volamus," (Through the Night we Fly). (Right) Badge of No. 51 Bomber Squadron, R.A.F.—"Swift and Sure."

Roll of Honour

Casualty Communiqué No. 547.

THE Air Ministry regrets to announce the following casualties on various dates. The next of kin have been informed. Casualties "in action" are due to flying operations against the enemy; "on active service" includes ground casualties due to enemy action, non-operational flying casualties, fatal accidents and natural deaths.

Of the names in this list 202 are second entries giving later information of casualties published in earlier lists.

Royal Air Force

KILLED IN ACTION.—Sgt. G. H. Fletcher; L.A/C. W. Bland; Sgt. R. F. Clarke; Sgt. G. Davies; F/O. R. E. Farrow; L.A/C. W. R. Fletcher; L.A/C. W. Langan; Cpl. H. W. Leach; P/O. W. A. Mitcham; P/O. W. H. Mitton; Flt. Sgt. J. Sanderson; Act. Flt. Lt. J. R. Sherwood; Sgt. A. M. Sliman; F/O. C. P. K. Smith; Flt. Sgt. W. G. Warden; P/O. E. J. Wilby.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Sgt. A. E. Jeans; F/O. C. H. Mason; P/O. J. S. Peacey.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—P/O. T. A. Allen; Sgt. E. Anthony; Flt. Lt. L. R. Aust, D.F.C., D.F.M.; Flt. Sgt. P. A. G. Bailey; Flt. Sgt. F. M. Bennett; Sgt. J. E. Benson; Flt. Sgt. S. Binns; Sgt. C. Bird; F/O. G. A. Blair; Act. Sqn. Ldr. K. F. P. Bond; Flt. Lt. V. G. Brewis; P/O. A. W. C. Bugden; Sgt. W. Burke; Sgt. C. I. D. Campbell; Flt. Sgt. W. W. Campbell; Sgt. J. B. Carr; Flt. Sgt. G. E. Clover; Sgt. A. R. Croft; Sgt. J. Cunningham; Flt. Sgt. W. Currie; F/O J. Downie; Flt. Sgt. S. P. Dullaghan; Sgt. L. S Dwan; Act. Flt. Lt. E. L. Eames; Flt. Sgt. T. L. Eastham; F/O. P. J. Edmonds; P/O. D. T. G. Fairbairn; Sgt. R. E. Foulds; Sgt. D. E. Froggatt; Sgt. J. Fulton; P/O. F. G. Gardiner; Sgt. H. W. Gee; Sgt. J. E. Girdwood; Flt. Sgt. P. C. Goddard; Flt. Lt. F. Gribble; F/O. J. Guile; P/O. J. E. Hall; Sgt. J. Hancock; Sgt. J. Hanna; P/O. C. R. Hanson; Flt. Sgt. W. Harris; F/O W. W. Heaton; Sgt. A. M. Henderson; Flt. Sgt. L. A. Hinch; Sgt. K. Hodgkinson; F/O. C. L. Hodsman; Sgt. R. S. Hollingum; W/O. G. C. C. Holmes; Flt. Sgt. E. G. Housden; Flt. Sgt. G. Hughes; Sgt. B. W. Jarvis; Sgt. P. A. Kemp; Sgt. W. R. Kennedy; Sgt. W. D. Knight; Sgt. T. Langan; Sgt. B. J. Lee; Flt. Sgt. G. F. Livingstone; Flt. Lt. D. A. Long; Sgt. E. Long; Flt. Lt. R. N. P. Luff; W/O. H. McIllaney; Flt. Sgt. J. A. McKerrow; Sgt. S. H. Mackey; Sgt. A. McLaughlin; Flt. Sgt. H. MacLeod; Sgt. D P. Mangan; Flt. Sgt. F. J. Marrington; Sgt. H. J. Mather; Sgt. D. K. Messenger; Sgt. A. S. Millar; Sgt. R. S. Millar; F/O. J. H. Mills; Sgt. A. R. Mitchell; Sgt. J. A. Mitchell; Sgt. H. MacD. Mundy; W/O. E. Munslow; Sgt. F. F. Naismith; Sgt. J. Oldfield; Sgt. T. Oulton; Sgt. W. A. Palmer; Sgt. J. G. P. Payne; F/O. H. F. Peacock; Sgt. R. W. Pryce; F/O. H. E. Pugsley; Sgt. A. G. Puiu; Sgt. H. W. V. Quelch; Sgt. L. J. C. Rainbow; Sgt. G. Reid; Sgt. W. L. A. Restell; Sgt. A. J. Ridgway; Flt. Sgt. L. J. Robey; Flt. Sgt. J. H. Ross; P/O. V. G. Ross; P/O. A. P. Rudland; Sgt. J. H. Sallis; Sgt. D. A. Sanderson; F/O. C. W. Saunderson; Sgt. F. Sedgwick; Sgt. M. C. Sewell; Flt. Sgt. E. Shepherd; Sgt. R. Shipley; Sgt. K. O. Smith; Sgt. R. E. Smith; Flt. Sgt. R. Smyth; W/O. F. T. Softley; Flt. Sgt. E. F. Stannett; W/O. G. E. Stansfield; Flt. Lt. H. Steere, D.F.C., D.F.M.; Flt. Sgt. D. G. C. Thorpe; Sgt. E. Tickner; Sgt. A. E. Till; Sgt. C. R. Todd; Sgt. R. F. Toland; F/O. F. Tovery; Sgt. J. A. Vick; P/O. R. C. H. Wakeley; Sgt. K. R. J. Warren; P/O. K. A. Wells; F/O. J. M. Wesley; Sgt. D. White; Sgt. J. A. White; Sgt. E. Whitehead; F/O. H. G. Whitley; P/O. O. L. C. Whittingham; Flt. Sgt. H. E. Wootton.

PREVIOUSLY REPORTED MISSING, NOW REPORTED KILLED IN ACTION.—P/O. A. Aiston; F/O. J. B. T-H. Bigland; F/O. H. Coker; F/O. F. Holbrook; P/O. C. M. Houghton; Sgt. R. L. Lee; F/O. F. J. Lockwood; Sgt. C. Small; F/O. F. P. Walker; Sgt. P. J. Wilson.

WOUNDED OR INJURED IN ACTION.—Sgt. W. J. Enright; Sgt. F. V. Steele; Flt. Sgt. C. F. Turner.

DIED OF WOUNDS OR INJURIES RECEIVED IN ACTION.—W/O. V. W. Groensmith.

MISSING, BELIEVED KILLED IN ACTION.—Flt. Lt. R. A. Done; F/O. A. E. Easterbee; W/O. R. S. Knight-Clarke; Flt. Lt. P. C. Schaefer.

MISSING.—Flt. Sgt. T. C. Ackroyd; Flt. Sgt F. O. G. Ayres; Flt. Sgt. A. C. Barr; Sgt I. A. Birrell; Flt. Sgt. K. W. G. Blackburn; F/O. A. S. Blake; P/O. J. G. Burns; F/O F. L. Burton; Flt. Sgt. F. Cairns; Flt. Lt H. Cobb; Flt. Sgt. J. B. Coffey; Flt. Lt. R. E. Cox; Flt. Sgt. A. J. Croley; Flt. Lt W. R. F. Curry; Act. F/O. J. Day; Sgt R. F. S. Dunkley; Flt. Lt. K. H. Eames; Flt Sgt. R. Edmondson; Flt. Lt. J. Featherstone; Flt. Sgt. N. L. G. Felton; Sgt. P. Fitzpatrick; Sgt. E. Ford; Sgt. B. M. Frankal; Flt. Sgt G. Furnandiz; F/O. E. O. Griffith; F/O C. B. Hamilton, D.F.C.; Sgt. W. P. Hayman; W/O. R. J. Hedge; Sgt. J. D. Hollick; F/O. W. Houghton; W/O. S. N. Hunsdon; P/O. J. S. Johnston; Flt. Sgt. A. W. Jones; Flt. Sgt. S. E. Jones; Flt. Sgt. E. Kelly; Flt. Lt. F. Leigh; Flt. Sgt. A. Lewis; Act. Flt. Lt. A. J. Lewsley; Sgt. L. F. McGuire; Act. Sqn. Ldr. M. V. L. Muller; Flt. Sgt. J. P. Newbiggin; F/O. M. H. Pattison; P/O. F. Pilling; P/O. E. Platt; Sgt. A. P. Poon-Tip; Act. Sqn. Ldr. D. H. Pruden, D.F.C.; Flt. Lt. P. B. O. Ranalow; F/O. K. W. T. Rigby; F/O. T. B. Robinson; P/O. D. W. S. Sharkie; Flt. Sgt. R. F. Sheen; F/O. R. C. Squire; F/O. V. B. Symes; F/O. A. K. Taylor; Sgt. G. E. Thomson; F/O. L. C. Turner; F/O. J. L. Vickery; Sgt. E. A. Walker; F/O. R. C. Webster; Flt. Sgt. G. E. R. Westacott; Sgt. J. D. Whitelaw; Flt. Lt. A. J. Winder; Flt. Lt. P. V. Wood; F/O. S. C. York; F/O. W. Young.

KILLED ON ACTIVE SERVICE.—F/O. I. M. Anderson; F/O. W. S. Baker; Act. Wing Cdr. T. P. A. Bradley, D.S.O., D.F.C.; F/O. E. B. Carss; Sgt. R. B. R. Cook; Sgt. H. A. Cooper; L.A/C. R. E. Dowen; Flt. Sgt. J. A. Evanson; F/O. C. C. Holmes; Sgt. S. J. Kingdon; Flt. Lt. N. J. Lucas, D.F.C.; Sgt. E. H. J. Martin; Flt. Sgt. J. M. Moore; Flt. Sgt. R. Ollerton; F/O. G. H. Rayner; F/O. E. L. Roberts; F/O. B. A. Savage; Flt. Lt. J. R. Smith; P/O. H. P. Speed; Sgt. T. J. H. Westoby; Flt. Lt. S. Wetherell.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED ON ACTIVE SERVICE, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Flt. Sgt. J. H. R. Platt; Flt. Sgt. R. H. Terry.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Sgt. G. A. Bradley.

DIED ON ACTIVE SERVICE.—Cpl. R. Adams; A/C.1 J. W. Baker; Act. Cpl. A. Beecroft; A/C.2 A. Dennett; Cpl. W. J. Edmeades; L.A/C. L. B. Edward; L.A/C. H. Fraser; L.A/C. F. Garwood; A/C.2 S. L. Leslie; L.A/C. T. O'Brien; L.A/C. C. W. Owen; Act. Flt. Sgt. F. W. Rooms; A/C.1 W. Sadler.

Women's Auxiliary Air Force

DIED ON ACTIVE SERVICE.—L.A/CW. L. A. Fielder.

Royal Australian Air Force

KILLED IN ACTION.—P/O. M. H. G. Rendall.

MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—F/O. N. Mac Donald.

(Left) Badge of No. 156 Squadron, R.A.F.—"We Light the Way." (Right) Badge of No. 226 Bomber Squadron, R.A.F.—"Non Sibi Sed Patriae" (For Country, Not for Self).

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—P/O. T. A. Burnett; W/O. H. Burnside; Flt. Sgt. R. H. Campbell; Flt. Sgt. E. R. Clayworth; Flt. Sgt. J. K. Cory; Flt. Sgt. E. Daniels; Flt. Sgt. P. J. Dunford; P/O. L. W. Dunn; P/O. J. E. Estell; P/O. J. J. Fletcher; Flt. Sgt. K. R. Foster; Flt. Sgt. A. O. Gillett; P/O. J. A. Harris; W/O. L. Harrison; F/O. F. T. Hodge; Flt. Sgt. J. A. Hollands; F/O A. F. Hookway; Flt. Sgt. F. R. Hughes; P/O G. S. Hughes, D.F.C.; W/O. V. G. Kane; P/O L. J. Kelly; P/O. N. D. L. Lloyd; Act. Flt. Lt. F. W. Mack; Flt. Sgt. T. Mackrell; Flt. Sgt. N. W. Miles; F/O. A. E. Roberts; Flt. Sgt A J. Routley; Flt. Sgt. E. J. Ryan; P/O. J. A. Solomon; Flt. Sgt. W. G. Swanbury; P/O. W. V. Thurston; Flt. Sgt. K. W. Webb; Flt. Sgt. J. A. J. Whitburn; P/O. A. W. Wilson; Flt. Sgt. A. Woods.

PREVIOUSLY REPORTED MISSING, NOW REPORTED KILLED IN ACTION.—Flt. Sgt. S. S Solomons.

MISSING, BELIEVED KILLED IN ACTION.—W/O D. W. McCulloch

MISSING.—Act. F/O. V. G. Berriman; F/O. R. R. N. Forrest; Flt. Sgt. C. J. Hodge; F/O. L. Hole; W/O. A. W. Howe; Flt. Sgt. S. A. Jeffrey; P/O. B. M. E. McLeod; Flt. Sgt. S. D. Pearce; Flt. Lt. D. H. Rutter; Flt. Sgt. E. F. Shannon; Flt. Sgt. L. A. Stegman; F/O. V. L. Vallentine.

KILLED ON ACTIVE SERVICE.—Flt. Sgt. J. W. Hamilton.

WOUNDED OR INJURED ON ACTIVE SERVICE.—F/O. W. Y. Richardson, D.F.C., D.F.M.

Royal Canadian Air Force

KILLED IN ACTION.—Flt. Lt. P. M. Anderson, D.F.C.; F/O. R. E. C. Edwards.

WELL-GROOMED: The prototype Vampire a few days before the first flight in September, 1943; on the left are Mr. Geoffrey de Havilland and some of the staff. It is interesting to note that the prototype had the characteristic "D.H." fin and rudder outline which has disappeared in the production model.

SERVICE AVIATION

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Flt. Lt. R. E. Banks; F/O. T. Frederickson; P/O. W. A. Gray; F/O. J. W. H. McEachern; P/O. V. A. McPhee; F/O. W. H. Pedlar; P/O. I. T. Pelechaty; F/O. W. A. Porterfield; P/O. G. E. Ryan; F/O. J. Smith; W/O. D. W. Vaughan.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—P/O. W. N. Auld; Flt. Lt. H. E. Brown; F/O. W. E. M. Kon; F/O. G. E. Munro; Sqn. Ldr. W. R. Pettit, O.B.E., D.F.C.; P/O. E. A. Russell.

PREVIOUSLY REPORTED MISSING, NOW REPORTED KILLED IN ACTION.—P/O. F. G. Devereaux; P/O. L. Kirton; P/O. V. E. Nelson; F/O. W. H. Regimbal.

KILLED ON ACTIVE SERVICE.—F/O. W. H. Porritt.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Sgt. M. W. Card; Cpl. M. F. Kimmerly.

Royal New Zealand Air Force

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Act. F/O. J. D. O'Driscoll.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Act. F/O. I. M. Campbell.

MISSING, BELIEVED KILLED IN ACTION.—P/O. J. M. Brightwell; P/O. E. J. Foy.

MISSING.—P/O. I. H. Dustin; F/O. L. A. Graham; W/O. O. J. Mitchell; F/O. G. L. Peet; Act. Sqn. Ldr. K. C. Taylor-Cannon, D.F.C.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED ON ACTIVE SERVICE, NOW PRESUMED KILLED ON ACTIVE SERVICE.—F/O. F. A. Sanderson.

South African Air Force

KILLED IN ACTION.—Lt. K. O. Embling.

WOUNDED OR INJURED IN ACTION.—Lt. H. Koertzen.

MISSING, BELIEVED KILLED IN ACTION.—Lt. J. R. Dekema.

Casualty Communiqué No. 548

Of the names in this list, 201 are second entries giving later information.

Royal Air Force

KILLED IN ACTION.—Cpl. B. Bower; F/O. W. Donald; L.A/C. W. Farrington; Sgt. W. McR. Hannan; Sgt. F. T. Hare; Sgt. G. W. Harper; F/O. T. M. Hawkey; Sgt. J. B. Kirby; F/O. V. A. McDean; F/O. B. Mayers; F/O. A. D. Moore; W/O. A. G. Randall; Cpl. D. G. Redman; Flt. Lt. D. South.

MISSING, NOW PRESUMED KILLED IN ACTION.—Sgt. C. A. C. Le-Mee-Power.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Sgt. A. Barratt; F/O. F. G. Burgess; Sgt. R. J. Doughty; Flt. Sgt. E. R. Dunford; F/O. W. H. Escritt; Flt. Lt. F. H. Foden, D.F.C.; F/O. G. S. Lambert; Sgt. J. W. Lenton; Flt. Sgt. I. A. Lloyd; Act. Sqn. Ldr. G. D. Matthews; F/O. A. C. Porter; Flt. Sgt. A. Redmayne; Flt. Lt. W. L. Saunders-Knox-Gore; P/O. J. H. H. Springay; P/O. G. J. Thorne; F/O. C. N. West; Sgt. N. L. Young.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Sgt. T. E. Alexander; Sgt. A. H. Anderson; Sgt. K. Applegarth; Flt. Lt. C. J. K. Ash; W/O. H. Bath; Sgt. J. P. O. Bell; Sgt. P. E. Bennett; Sgt. J. F. Bleach; Flt. Sgt. W. H. Boon; Flt. Sgt. H. Brawn; Sgt W. H. Carr; Sgt. C. O. Channing; Flt. Sgt. H. J. Chester; Sgt. R. J. Clarke; F/O. J. C. Corlett; Act. Wing Cdr. M. Crocker, D.F.C.; Sgt. T. S. Cumbor; Flt. Sgt. D. J. MacC. Currie; Sgt. R. E. Dance; Sgt. J. B. D'Arcy; Sgt. N. Davis; Sgt. N. H. Dew; Sgt. R. E. Dodson; Sgt. D. P. Duggan; F/O. T. W. Dunk; Sgt. L. T. Dunn; Sgt. B. S. W. Elliott; Sgt. W. Farquharson; F/O. J. D. F. Flannery; Flt. Sgt. F. Foster; W/O. J. A. Foubister; Sgt. F. J. Franklin; Sgt. J. R. French; Sgt. P. Gaffney; W/O. R. A. Garrett; Act. Flt. Sgt. L. E. Gibbs; F/O. H. D. Gillis, D.F.C.; F/O. R. L. Griffin; Flt. Lt. D. H. Griffiths; Flt. Sgt. H. L. Guy; W/O. R. F. J. C. Hall; Act. Sqn. Ldr. R. L. Hanbury; Flt. Sgt. T. W. Hill; Flt. Sgt. J. W. Hobson; P/O. T. W. Hope; Sgt. E. Hopkinson; P/O. H. Hugill; Flt. Sgt. J. C. L. Humphrey; Flt. Sgt. C. O. V. Hunt; Sgt. L. G. Knight; Sgt. W. P. Larvin; Flt. Sgt. K. G. Lawrence; Sgt. J. V. Lea; Sgt. A. H. Leame; Sgt. P. J. McCarthy; F/O. H. H. Marsh; Sgt. G. L. Mills; Sgt. H. D. Mitchell; Act. Flt. Lt. P. J. Moyes; Sgt. D. A. F. Mundy; F/O. R. J. Newens; F/O. W. Ogston; Flt. Sgt. R. Osborne; Sgt. E. A. Osman; Sgt. C. A. Page; Sgt. D. Parker; Sgt. R. Parkin; Sgt. W. Patterson; P/O. W. G. Pearcey; W/O. J. V. Pearson; F/O. C. S. Purkis; W/O. G. Radcliffe; Sgt. W. T. Reaveley; Sgt. N. E. Redhead; Sgt. T. B. Rees; Flt. Sgt. G. Reid; Sgt. A. Richardson; Flt. Lt. G. C. Robinson; Flt. Sgt. J. W. Robinson; Flt. Sgt. E. W. Royal; Sqn. Ldr. W. D. B. Ruth, D.F.C.; Sgt. A. A. J. Ryan; Flt. Sgt. D. Sharland; F/O. J. H. Siddell; Sgt. H. Skellorn; Sgt. D. E. South; Flt. Sgt. K. C. Spiers; Sgt. L. R. Swann; Sgt. L. Sykes; Flt. Sgt. J. Taylor; P/O. M. G. M. Warren; P/O. A. Warrington; Flt. Sgt. E. Watson; Act. Sqn. Ldr. D. M. Wellings, D.F.C.; P/O. J. W. Wells; Sgt. A. E. White; F/O. R. J. White; P/O. L. E. Wilkinson; Sgt. W. I. Williams; Act. Flt. Lt. D. T. Wood, D.F.C.; Flt. Sgt. F. G. Woods; F/O. G. L. Woolven; F/O. J. R. Worthington, D.F.C.; Flt. Sgt. L. Wright.

PREVIOUSLY REPORTED MISSING, NOW REPORTED KILLED IN ACTION.—Flt. Sgt. F. Allen; Sgt. J. Allison; Flt. Sgt. S. R. Bore; Sgt. J. Boutle; Sgt. G. G. Clark; Sgt. R. E. De Casagrande; F/O. E. A. Duerr; F/O. R. J. Dunstan; Flt. Lt. M. T. Flood; Sgt. R. L. Hanson; Flt. Lt. J. C. I. Hooper, D.F.C.; F/O. S. C. Hubbard, D.F.M.; Sgt. H. W. F. Jordan; F/O. H. A. Little; Sgt. D. C. Scott; Sgt. N. Scott; Sgt. J. A. Williamson.

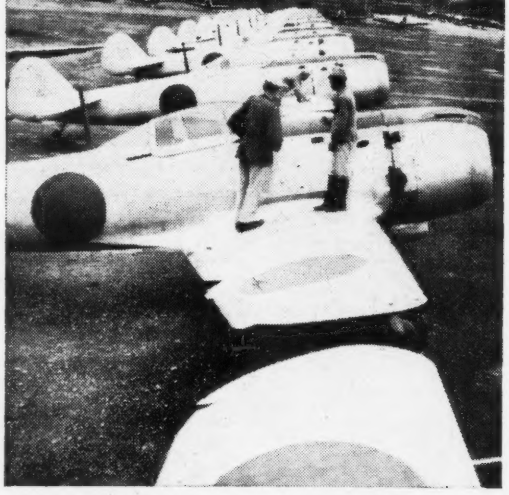
WOUNDED OR INJURED IN ACTION.—F/O. H. C. Finbow; P/O. B. G. Roberts.

DIED OF WOUNDS OR INJURIES RECEIVED IN ACTION.—Sgt. G. Peace.

MISSING, BELIEVED KILLED IN ACTION.—Flt. Sgt. P. Anson; Sgt. E. F Buchan; F/O. R. D. Franks.

MISSING.—Flt. Lt. A. G. Anderson; Flt. Lt. F. Beresford; Sgt. H. K. Bradbu'n; Sgt. A. Card; Flt. Sgt. R. A. W. Dawkins; W/O. L. Green; F/O. J. Harris; Flt. Sgt. R. G. Hogben; Flt. Sgt. D. W. Horton; Sgt. W. Hunter; W/O. C. R. Jarratt; Sgt. L. Jeffrey; P/O. G. B. Knight; Sgt. G. Riley; Sgt. W. J. R. Semple; Flt. Sgt. D. C. R. Smith; Flt. Lt. J. R. Tracey.

KILLED ON ACTIVE SERVICE.—Flt. Sgt. J. A. A. Chantler; Sgt. L. A. Cooke; Flt. Sgt. A. F. Cooper; Flt. Sgt. E. A. Crutchfield; Sgt. P. L. Doggett; W/O. W. Erskine; Sgt. H. J. Farrier;



GROUNDED: A line of Japanese "Frank" fighters at Ustunomiya, Northern Honshu, waiting to be taken over by the Americans.

Sgt. D. H. Folwell; F/O. W. W. Ford; Sgt. P. J. Froggatt; Flt. Sgt. G. N. Hayes; Sgt. I. J. Hitchens; Flt. Sgt. A. C. Hope; Sgt. C. King; F/O. J. N. Kocaj; Flt. Sgt. G. A. Leek; F/O. J. L. Riddle; F/O. O. H. Simmons; Sgt. S. G. Stranks; Sgt. S. A. Turley; W/O. E. G. Turner; Sgt. W. Wallwork; Sgt. N. Willows; Sgt. W. J. Wilson

MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Wing Cdr. W. H. Biddell, O.B.E., D.F.C.; F/O. A. N. Brodie; Air Marshal Sir P. R. M. Drummond, K.C.B., D.S.O., O.B.E., M.C.; Act. Sqn. Ldr. E. G. Plum.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED ON ACTIVE SERVICE, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Flt. Sgt. E. A. Walker; W/O. W. H. Watts.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Sgt. G. J. Baldwin; Flt. Sgt. B. A. K. Brown; Flt. Sgt. A. C. Freeman; Sgt. H. Glasper; P/O. N. Hesketh; Sgt. G. C. Hinves.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Sgt. E. D. Dash; Sgt. D. Neilson.

DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—L.A/C. F. Bentley; Sgt. G. A. Martin.

DIED ON ACTIVE SERVICE.—Cpl. T. Brady; L.A/C. J. Dangerfield; L.A/C. R. W. Jarvis; L.A/C. T. Oliver; Flt. Lt. S. H. Paget; Cpl. H. F. Papworth; A/C.1 J. Wightman

Women's Auxiliary Air Force

DIED ON ACTIVE SERVICE.—L.A/CW. R. E. Cox; A/CW.1 I. P. Weaver.

Royal Australian Air Force

MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—W/O. W. T. D. Furlong; Flt. Sgt. A. E. Williams.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—W/O. J. H. Pugh.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Act. Flt. Lt. R. C. Anderson; Flt. Sgt. J. E. Brown; F/O. L. J. Calderwood; P/O. P. C. L. Dombrain; P/O. N. J. Higgins; Flt. Sgt. L. Ireland; Flt. Sgt. A. F. Johnson; Flt. Sgt. J. T. Kerr; Flt. Sgt. A. S. Long; Flt. Sgt. D. J. McDonald; Flt. Sgt. W. W. Moore; Flt. Sgt. V. W. Phillips; W/O. C. A. Pickup; Flt. Sgt. F. B. Reid; Flt. Sgt. J. K. Richards; P/O. S. L. Rowe; Flt. Sgt. R. G. Sauerwald; F/O. C. C. Schomberg; F/O. H. W. Watkins.

PREVIOUSLY REPORTED MISSING, NOW REPORTED KILLED IN ACTION.—Flt. Sgt. J. L. Brosnan; Flt. Sgt. G. C. Groves; Flt. Sgt. R. M. Howell; Act. Flt. Lt. H. G. M. Robipson, D.F.C.; Flt. Sgt. R. P. Templeton; Act. F/O. J. K. Waring.

MISSING.—Flt. Sgt. J. N. Donald; Flt. Sgt. C. F. Ford; Flt. Sgt. J. C. Hughes; P/O. N. W. N. Tanner.

KILLED ON ACTIVE SERVICE.—Flt. Sgt. W. J. Brooker; Flt. Sgt. A. G. S. Brunskill; Flt. Sgt. R. W. Faulks; Flt. Sgt. E. C. Graebner; W/O. C. H. Harrison; Flt. Sgt. J. W. Newcombe; Flt. Sgt. J. R. Thomas; Flt. Sgt. J. K. Vickers.

MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Flt. Lt. K. G. Shea.

Royal Canadian Air Force

KILLED IN ACTION.—P/O. M. S. H. Anderson; P/O. C. N. Armstrong; P/O. E. T. Ashdown; P/O. J. E. R. Beaudry; P/O. A. G. Brett; F/O. R. E. O. Charron; F/O. E. W. Clark; P/O. J. A. Epoch; F/O. J. N. Friesen; P/O. R. J. S. Green; F/O. P. J. Hall; F/O. R. M. Hays; Flt. Sgt. C. K. Howes; Flt. Sgt. J. W. Hyde; F/O. A. R. Lowe; Sgt. J. L. Lynch; P/O. K. McC. Merriam; F/O. J. B. Millar; Flt. Lt. R. E. Naylor; F/O. W. H. Oakes; P/O. J. L. G. Pelletier; P/O. H. E. Rickert; Sgt. S. J. O. Robinson; F/O. J. Rochford; Sgt. J. D. F. Roy; Flt. Sgt. J. L. P. Seguin; P/O. J. T. Steventon; F/O. L. S. Stockwell; W/O. S. McL. Thomson; F/O. J. W. Watson.

MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—F/O. B. A. Burrows; Flt. Sgt. G. L. Cofield; F/O. W. R. Lay; F/O. F. W. Shantz.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Flt. Lt. G. A. Argument; W/O. L. J. Baxter; P/O. J. D. Clark; F/O. C. E. Fairfield; Flt. Lt. A. E. Miron.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. H. Backler; P/O. D. McM. Boyd; P/O. J. A. Buckham; F/O. D. D. Connor; F/O. J. W. B. Earle; Flt. Sgt. E. L. Eitel; P/O. M. Fetchison; F/O. B. G. Foy; F/O. H. A. Fuhr; Flt. Sgt. H. D. Hilts; W/O. J. W. J. P. Huot; F/O. D. L. Irwin; Flt. Sgt. L. Johnston; P/O. R. C. Joiner; F/O. J. A. Linklater; P/O. D. More; P/O. J. D. Morton; F/O. L. F. O'Brien; P/O. J. L. Shanks; P/O. A. G. Sinclair; F/O. L. T. Sykes; F/O. P. N. T. Van Alstyne.

KILLED ON ACTIVE SERVICE.—F/O. W. J. Chittenden; F/O. A. D. Fraser; F/O. J. C. Simpson; Flt. Lt. J. B. Thompson.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Flt. Lt. J. C. Davidson.

Royal New Zealand Air Force

KILLED IN ACTION.—F/O. A. J. Coe; Act. Sqn. Ldr. I. G. Medwin.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—F/O. L. A. A. Kilgour.

WOUNDED OR INJURED IN ACTION.—Act. Flt. Lt. R. A. Ayton.

MISSING.—Flt. Sgt. W. I. Davidson.

KILLED ON ACTIVE SERVICE.—F/O. C. R. Baker, D.F.C.; Flt. Sgt. C. W. Burt; F/O. D. J. Dickson; Flt. Sgt. S. Fernyhough; Flt. Sgt. E. D. Hitchins; Flt. Sgt. G. T. Matthews; F/O. J. A. Millar; F/O. J. A. P. Nicholls; Flt. Sgt. J. P. Redpath

South African Air Force

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Capt. C. H. Campbell.

Official Corrections

Casualty Communiqué No. 546.

Under "MISSING, BELIEVED KILLED IN ACTION," delete Flt. Lt. E. G. Hutchin.

R.C.A.F.—Delete the heading "PREVIOUSLY REPORTED MISSING, NOW REPORTED KILLED IN ACTION" and the name beneath.

Under "MISSING, BELIEVED KILLED IN ACTION," delete Flt. Sgt. A. Dorey.